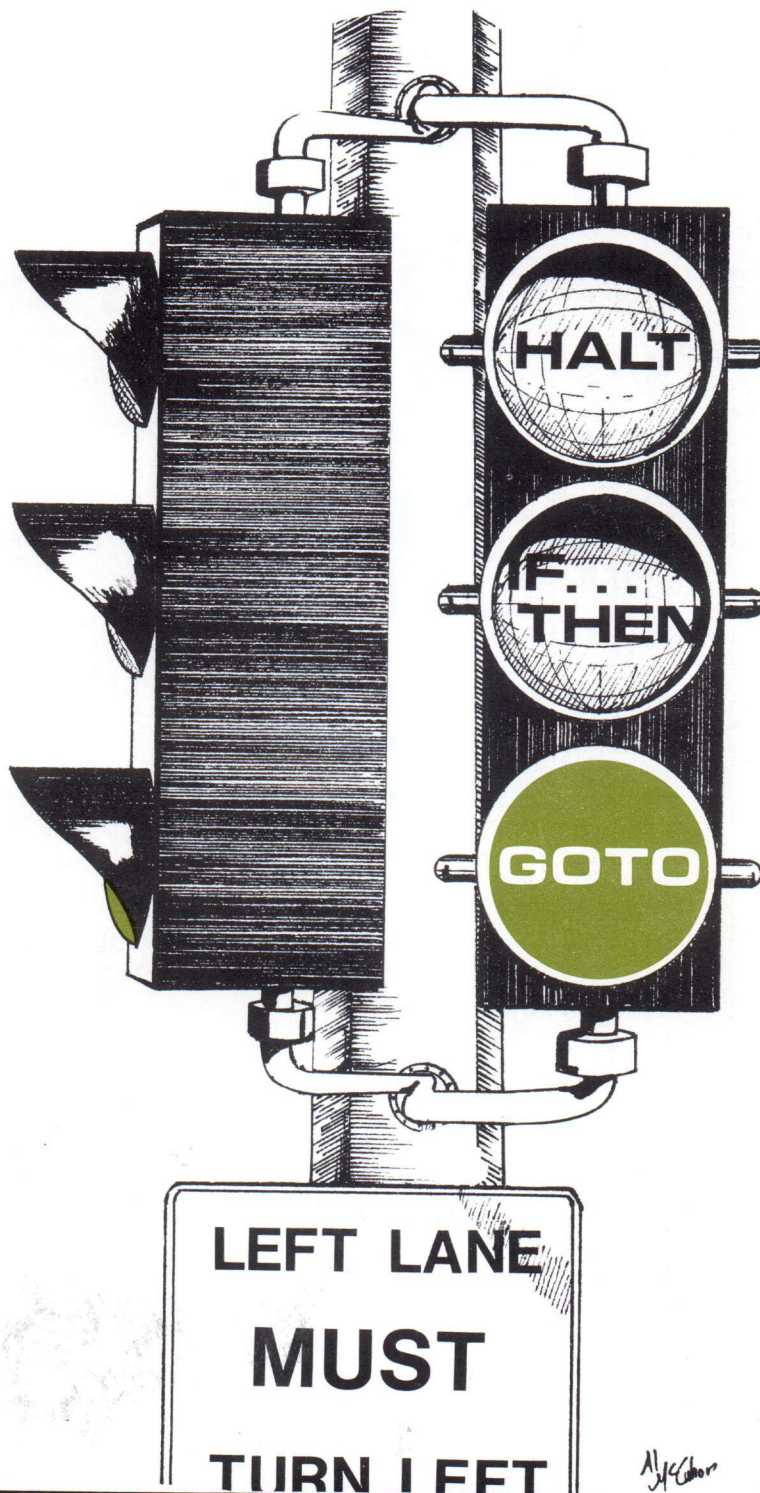# computer notes

50¢

April '77

Volume 2, Issue 10

take your cue

COMPUTER NOTES is continually seeking quality manuscripts on applications, troubleshooting, interfacing, software, book reviews, fiction, cartoons and a variety of other computer-related topics.

Articles should be a minimum of 800 words and a maximum of 3600 words long (about 15 pages typed double-space). Honorariums are based on an article's technical quality and its suitability for *C.N.'s* readership. Payment will range from 50¢ to $1 per typeset magazine column inch for all text and programs. No payment will be made for illustrations. All articles are subject to editing to fit space requirements and content needs of our readership. Payment for articles which are accepted will be sent upon publication.

Articles submitted to *C.N.* should be typed, double-space, with the author's name, address and the date in the upper left-hand corner of each numbered page. Authors should also include a one-sentence autobiographical statement about their job, professional title, previous electronic and/or computer experience under the article's title. Authors should retain a copy of each article submitted.

Photos, charts, programs and figures should be clearly labelled and referred to by number within the text of the manuscript. Only clear, glossy black and white photos (no Polaroid pictures) can be accepted. All photos should be taken with uniform lighting and sharp focus.

Program listings should be recorded with the darkest ribbon possible on blank white paper.

Articles which are not accepted will be returned.

Computer Notes
Attn. Linda Blocki
2450 Alamo SE
Albuquerque, New Mexico 87106

BITS AND PIECES

By Sondra Koppenheffer

Computer Notes Subscriptions

Anyone who purchases an Altair microcomputer directly from MITS or one of our dealers, will receive a free one-year subscription to COMPUTER NOTES. However, after that first year, subscriptions must be purchased at our regular rate of $5 per year in the U.S. and $20 per year overseas. Beginning with subscriptions that expire in April, 1977, we will send out renewal notices one month prior to expiration. Due to the large volume of mail we handle, we can only accept one-year subscriptions to C.N. and send them all via bulk rate.

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After a refund is requested, please allow up to three weeks for receipt of your check. If you don't receive your check after three weeks, please contact us.

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Software

The following suggestions and prices should help with the purchase of software copies and updates.

When updating BASIC, simply take the difference between the two versions and add either a $15 (4K, 8K and Extended BASIC) or $25 (Disk Extended BASIC) copying charge plus $1 for postage and handling.

Updating:

4K to 8K BASIC

    $15 difference
    + $15 copying charge
    $1 postage & handling
    Total: $31

4K to Extended BASIC

    $90 difference
    + $15 copying charge
    $1 postage & handling
    Total: $106

4K to Disk Extended BASIC

    $140 difference
    + $25 copying charge
    $1 postage & handling
    Total: $166

8K to Extended BASIC

    $75 difference
    + $15 copying charge
    $1 postage & handling
    Total: $91

8K to Disk Extended BASIC

    $125 difference
    + $25 copying charge
    $1 postage & handling
    Total: $151

Extended BASIC to Disk Extended BASIC

    $50 difference
    + $25 copying charge
    $1 postage & handling
    Total: $76

The above prices, which are subject to change without prior notification, apply only to customers who are eligible for minimum system price discounts. If you have not purchased a minimum system from MITS or one of our dealers, you must pay the full amount each time you order BASIC. Any versions of BASIC other than those listed above that you have purchased, can be obtained only for a copying charge.

New Computer Publications Emphasize Self-Instruction

DYMAX now offers three new publications--YOUR HOME COMPUTER, INSTANT BASIC and CALCULATOR/ COMPUTER Magazine--specifically designed for home or classroom instruction in basic computer operation, beginning programming and practical computing material for educational purposes.

Written for the computer novice, YOUR HOME COMPUTER introduces the reader to general microcomputer functioning and programming in addition to some of the exciting happenings in personal computing. Author James White has included such special features as:

- guidelines for selecting and building your own microcomputer
- how to use your home computer
- lists of computer clubs and stores
- personal computing periodicals
- clearly defined terminology

YOUR HOME COMPUTER is well-suited for classroom usage, because it is written in an easy-to-understand style and includes review questions at the end of each chapter.

INSTANT BASIC is written by Jerald Brown, one of the authors of the classroom-oriented text BASIC.

IN THIS ISSUE

Inspection Helps Avoid Teletype Interfacing Problems

By Doyl Watson

The Altair SIO and 2SIO interface boards come from the factory with provisions for driving Teletype terminals. Before connecting the Teletype to the computer, however, some preliminary checks and adjustments must be made to the Teletype. The following list includes some checks and adjustments that should be made as well as some diagnostics for checking the operation of your system.

1) Conversion of Teletype:

Converting your Teletype from 60 milli-Amp half duplex to 20 milli-Amp full duplex operation is a simple process. If the unit is a MITS call control, no conversion is necessary. If the call control is a Teletype "Private Wire Call Control" (i.e. line-local, off knob), the conversion can easily be done because of the standard color-coded wiring.

Remove the cover (see manual). The call control has several 15-pin Molex connectors in the back. Beneath them, with a protective covering, is the terminal block where connections to the computer are made. Locate and remove the brown-yellow wire on the terminal block position 3 and remove the white-blue wire from 4. Connect both wires to 5. Then remove the purple wire from 8 and connect it to position 9.

2) Connection of Teletype to I/O Card:

The 2SIO or SIOC cards should be connected as shown in Figure 1. Be sure to check the system operation before replacing the cover.

3) Proper Operation of the System:

The operation of the computer-Teletype combination can be tested with an "echo loop." (Refer to the manuals on your particular I/O board for manual loading of echo routines.)

The following is a useful routine for transmitting characters from the sense switches to the Teletype.

This routine repeatedly prints the character "U" or "*!" on your Teletype until you press "STOP." If the above program and your echo routines run correctly, your Teletype is free of any problems.

4) Visual Inspection:

If problems still exist, check power, connections and fuses. If your Teletype works in "LOCAL" but not "on line," the problem is in the call control circuit or in the I/O board. If the Teletype runs open "on line" but not in local, short the Ground to the "Xmit" line of the 25-pin Molex connector (pins 2 to 3). If this closes the circuit, the trouble is in the computer and not in the Teletype. If the problem also appears in "LOCAL," check the printing and tapes for garble.

To check for garbled printing, turn the Teletype switch to "off" and depress a key. Cautiously rotate the plastic motor fan forward until a definite pattern appears in the code bars under the carriage of the unit. The code bars are numbered "S 1 2 3 4 5 7 6 8" from the back. (S is for spacing.) If the bar is raised, that bit is 1.

Look for obvious broken, worn or shorted parts. Don't try to repair any but the simplest problems. The Model 33 is an amazing but delicate piece of mechanical hardware, and breaking a part will not only cause more problems but will void your warranty.

Continued on Page Three

OCTAL ADDRESS	2SIO (Instruction)	SIOC
000	076	333
001	003	377
002	323	323
003	020 (Control Channel)	001 (Data Address)
004	076	303
005	021	000
006	323	000
007	020 (Control Channel)	Lower switches A15-A0 and
010	333	press EXAMINE. Set up
011	377	ASCII Code of the echo
012	323	character on switches
013	021 (Data Channel)	A15-A8. (01010101 is a
014	303	"U" and 10101010 is an "*.")
015	010	Press RUN
016	000	

Examine to 000. Set up ASCII Code. (010 10101 is a "U") RUN.

(front)

(for an R0 set, omit rec. lines)

```
         1 2 3 4 5 6 7 8 9 10    10-pin molex
                                 connector
              transmit
            ground   receive     (rear)
                     no pol.
         1 2 3 4 5 6 7 8 9        TTY terminal block
```
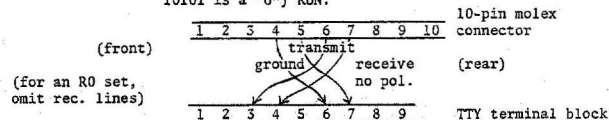
TWO Figure 1

Game Corrected

The following corrections should be noted in BAGLES (Altair Software Library #5-6-761, see August issue of C.N.). In line 9090 an "=" should replace the "-."

Line 9030 should read LEN(C$)) rather than (LEN(CS). This error is caused when, under certain circumstances, STR$(INT((D/BT-INT(D/BT))*BT)) is not equal to Q=INT ((D/BT-INT(D/BT))*BT): STR$(Q). Therefore, the following patch will result in a fix:

9080 Q=(D/BT-INT(D/BT))*BT:B$= B$+STR$(Q):D=INT(D/BT): IFD = 01/BT THEN 9080

New Club Formed

A new computer club was recently formed in Bloomington, Indiana. The Bloomington Association for the Computer Sciences is now holding regular meetings. For more information, contact club president:

Remy M. Simpson
901 East 13th St.
Bloomington, Ind. 47401
(812)-339-1046

WACC-II POSTPONED

The second World Altair Computer Convention II, advertised on the back cover of March COMPUTER NOTES, has been postponed until later this year. The major reason for the postponement is time--the WACC-II was scheduled too close to the NCC, which caused difficulties for people who wanted to attend both conventions.

We wish to thank everyone who expressed an interest in the WACC-II. We hope that you will continue your support in the future.

Watch future issues of COMPUTER NOTES for more information about the rescheduling of WACC-II.

Charles Olsen
Public Relations

SOFT WARE TIDBITS

By Mark Chamberlin

1. **A fix for the EOR bug in the Altair 680 Assembler 1.0:**

Due to an erroneous table entry in the Altair 680 Assembler, the EOR opcode does not assemble properly. This problem can be solved by simply using the Monitor's M command to deposit an $88_{(16)}$ into location $03A7_{(16)}$ after the Assembler is loaded. My thanks to John E. Smith of Colorado Springs, Colorado, for bringing this problem to the attention of the MITS Software Department.

2. **Using CSAVE and CLOAD in 8800 BASIC 4.0:**

A number of users of Altair BASIC 4.0 have asked about the use of the CSAVE and CLOAD commands. In earlier versions of Altair BASIC, these commands had the form CSAVEX and CLOADX, where X was a single character file name. In Altair BASIC 4.0, the commands are of the form:

CSAVE string expression and
CLOAD string expression.

A string expression is a formula which, when evaluated, results in a character string. In its simplest form, a string expression is merely a quoted character. For example, the command CSAVE"A" would save the program in memory on cassette under the name A.

Altair BASIC evaluates the string expression and uses the leftmost character of the resultant character string as the file name. So, CLOAD"ABC" is the same as CLOAD"A" because both commands load the file named A from the cassette. CSAVE A$ uses the leftmost character of the character string stored in the variable A$ as the file name.

All of the commands listed below are valid forms of CSAVE and CLOAD.

Command	Description
CSAVE"A"	Save program A
CLOAD"ABC"	Load program A
CSAVE A$	Save program specified by leftmost character of string in variable A$
CLOAD "3" + "FOO"	Load program 3
CSAVE "3"	Save program 3

By the way, programs CSAVED with 3.2 8K BASIC can be CLOADED with 4.0 8K BASIC. However, 3.2 and 4.0 Extended cassette files are not compatible.

Altair BASIC 4.0 also supports the csaving and cloading of numerical data. The commands are of the form:

CSAVE* array name
CLOAD* array name

where array name is the name of the array that contains the data to be saved or into which the data is to be loaded.

The array used must be dimensioned prior to using CSAVE* and CLOAD*. For example, the following program saves the numbers 0 through 99 on the cassette.

```
10   DIM A (99)
20   FOR I=0 to 99
30   A(I)=I
40   NEXT I
50   CSAVE*A
60   END
```

The file saved on cassette is not named, so it may be read back into any array of the same type and dimension. In other words, the array saved on tape in the example program above could be read back into an array C, which had been dimensioned with the statement:

DIM C(99).

If the array type is incorrect, the results will be undefined. If the size is not correct, Altair BASIC will do one of two things: (1) not read all of the data on the cassette (if the array being loaded into is smaller than the array on the cassette) or (2) continue to search the tape for more data and not return control to the terminal (if the array being loaded into is larger than the array on the cassette).

Inspection Helps Avoid Teletype Interfacing Problems

CONTINUED

5) **Adjustment for the Printer Rangefinder:**

Refer to issue 3, section 574-122-100TC, Vol. II of the TTY Manual. Note: The rangefinder may need to be lowered near to "40" for the printer to be compatible with the MITS Call Control Unit.

The rangefinder is the gauge at the left rear of the Teletype. To adjust the rangefinder, loosen the screw on the pointer plate to friction point. Raise and lower the pointer until typing errors occur. Then tighten the pointer in the center of this range.

b_7		0	0	0	0	1	1	1	1
b_6		0	0	1	1	0	0	1	1
b_5		0	1	0	1	0	1	0	1
b_4 b_3 b_2 b_1									
0 0 0 0	NULL	DC 0	b	0	@	P		
0 0 0 1	SOM	DC 1	!	1	A	Q		
0 0 1 0	EQA	DC 2	"	2	B	R		U N A S S I G N E D
0 0 1 1	EOM	DC 3	#	3	C	S		
0 1 0 0	EOT	DC STOP4	$	4	D	T	U N A S S I G N E D	
0 1 0 1	WRU	ERR	%	5	E	U		
0 1 1 0	RU	SYNC	&	6	F	V		
0 1 1 1	BELL	LEM	(apos)	7	G	W		
1 0 0 0	FE	S 0	(	8	H	X		
1 0 0 1	MT SK	S 1	)	9	I	Y		
1 0 1 0	LF	S 2	*	:	J	Z		
1 0 1 1	TAB	S 3	+	;	K	[		
1 1 0 0	FF	S 4	(comma)	<	L	\		ACK
1 1 0 1	CR	S 5	(hyphen)	=	M	]		①
1 1 1 0	SO	S 6	(period)	>	N	↑		ESC
1 1 1 1	SI	S 7	/	?	0	←		DEL

SOFT WARE TIDBITS

Disk BASIC Information:

A. Converting to 4.∅:

Program files saved under
Altair Disk BASIC 3.4 can be con-
verted for use under Altair BASIC
4.∅ by following this simple proce-
dure.

1) "Bring up" 3.4 BASIC
2) Load each program file and resave
   it in ASCII
3) "Bring up" 4.∅ and load PIP from
   the 4.∅ disk
4) Unload the 4.∅ disk
5) Mount the 3.4 diskette containing
   the files to be converted
6) RUN PIP's CNV function on the
   3.4 disk
7) All files on the 3.4 disk are now
   ready for use with 4.∅.

The CNV function in PIP 4.∅
must be run to insure that the stop
byte of each sector is in fact a 255
(for details, see sector format,
page 118, Altair 4.∅ BASIC manual).
Data files created under 3.4 are
ready for use with 4.∅ after the
CNV function has been run on the
disk on which they reside.

B. Stop! UNLOAD that disk first!

It is absolutely imperative
that an UNLOAD command be issued
before removing a diskette from its
drive. It is also necessary to
issue a MOUNT command each time a
disk is placed in the drive. The
following discussion will clear up
any confusion about why these com-
mands must be used.

Altair Disk BASIC dynamically
allocates disk space for program and
data files. It is therefore neces-
sary for BASIC to know what portions
of the diskette are in use and what
portions are free to be allocated
to new files. This information is
kept in a table in memory. The
table is constructed by the MOUNT
command.

The UNLOAD command tells BASIC
that the information in the disk
allocation table is not current.
It also disables the disk drive.
(Diskettes should not be removed
while the disk is enabled.)

The allocation information
differs for two different diskettes.
So, if a MOUNTed diskette is re-
moved from the drive and replaced
with another diskette without the
UNLOAD and MOUNT sequence, the allo-
cation information in memory will be
incorrect. If a file is saved with
this incorrect information, the
existing files on the diskette will
probably be overwritten by the new
file. This situation leads to
disaster! An attempt to access a
file that has been overwritten in
this manner produces a File Link
Error. So remember, every time you
change diskettes, do an UNLOAD and
a MOUNT.

FOUR

KCACR INCREASES ALTAIR 680B's POTENTIAL
By Thomas Durston
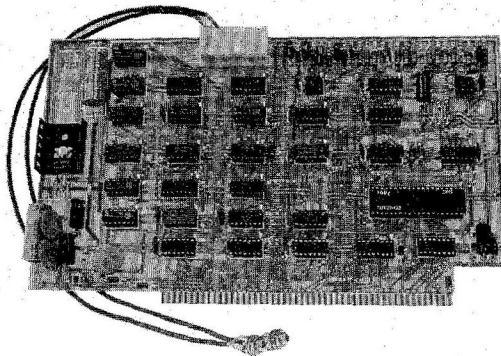
The Altair 680b has received
yet another boost to its limitless
versatility. With the introduction
of the 680b-KCACR Audio Cassette
Interface, the Altair 680b continues
to be one of the most powerful
computers for the money.

Designed to interface the 680b
bus with an audio cassette recorder/
player, the 680b-KCACR enables mass
storage and retrieval of data. The
KCACR circuitry is based on the
Kansas City Standard, making data
transfers highly reliable without
any component adjustments and under
widely varying conditions.

Other design features include
a digital demodulator, CMOS logic
allowing low power consumption, a
motor control circuit for starting
and stopping tape motion and the use
of test points at key circuit areas.

New Computer Publications Emphasize Self-Instruction

Brown developed INSTANT BASIC for
the reader with no previous pro-
gramming experience. The book is
written in a unique self-teaching
style in the popular Altair BASIC
and DEC BASIC PLUS. It includes
exercises that keep typing to a
minimum so that the reader can
focus his complete attention on
learning BASIC and developing good
programming techniques. Self tests
and activities are also included
for checking progress.

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void in the availability of prac-
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for educational purposes. The
goal of CALCULATORS/COMPUTERS
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hobbyists, teachers, etc. and to
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All ICs are socketed. A complete
set of documentation containing
diagnostic software, test point
waveforms, theory of operation and
a detailed operators section is
also provided.

Altair 680b CSAVE BASIC, avail-
able on audio cassette, has been
developed for use with the KCACR.
It includes the standard functions
and operators of 680b BASIC, along
with the capability of storing and
loading software through the 680b-
KCACR.

Check with your local dealer
for prices and availability.

Specifications

Frequencies used (self clocking)

LOCIG 1 = 2400 HZ
LOGIC ∅ = 1200 HZ

Data Rate: 300 BAUD (27 bytes/
            second)
            36.67 ms per byte (3.3
            ms per bit)

Data Format: One start bit - logic ∅
              Eight data bits
              Two stop bits - logic 1
              (11 bits per byte)

Demodulator
Playback
Speed
Tolerance: +20, -25% from recorded
            speed

Demodulator
Input Levels
(Playback): 300MV peak to peak
             minimum (100MV RMS)
             10V peak to peak maxi-
             mum (3.5V RMS)

Demodulator
Input
Impedance: 10K ohms

Modulator
Output
Level: 30MV P-P (suitable for micro-
        phone input)

Modulator
Output
Impedance: 1K ohms   CONTINUED

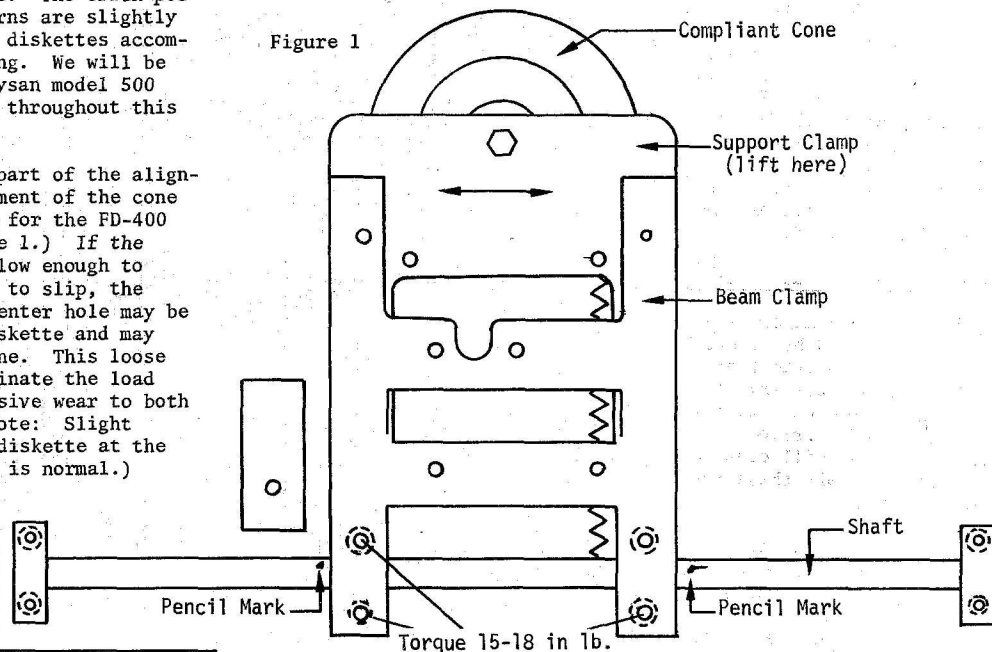# Altair Disk Drive Alignment Permits Precise Operation

By Tom Woods and Glenn Wolf

Maintaining proper alignment of the Altair disk drive is essential for trouble free operation of the floppy disk. The alignment involves the adjustment of the index pulse timing and head positioning (track and skew). Necessary equipment includes an oscilloscope with an A + B (differential mode), a CE alignment diskette (available through MITS, Part Number 101661 at $40.00 per disk), 1/4" nut driver, screwdrivers and a mallet.

There are two types of alignment diskettes available. The track positioning and patterns are slightly different, but the diskettes accomplish the same thing. We will be referring to the Dysan model 500 alignment diskette throughout this article.

An important part of the alignment is the adjustment of the cone clamping mechanism for the FD-400 drive. (See Figure 1.) If the clamping force is low enough to allow the diskette to slip, the oxide around the center hole may be scraped off the diskette and may build up on the cone. This loose oxide could contaminate the load pad, causing excessive wear to both pad and media. (Note: Slight scratching of the diskette at the cone clamping area is normal.)

To adjust the cone clamping mechanism, close the door and loosen the four screws (7/64 allen bit) that are holding the beam clamp to the shaft. Press firmly on the support clamp and move the beam clamp to the extreme right and left. Make a pencil mark on both ends of the shaft. Center the beam clamp between the two pencil marks. Exact centering of the beam clamp is essential for free motor spin.

Figure 1

(Labels: Compliant Cone, Support Clamp (lift here), Beam Clamp, Shaft, Pencil Mark, Pencil Mark, Torque 15-18 in lb.)

While pressing firmly on both sides of the beam clamp, open the door approximately 5/8" and tighten screws progressively. With the door closed, rest one finger lightly on both the support clamp and the compliant cone. Use a force gauge to pull upward on the end of the support clamp until you detect a slight relative motion between the cone and clamp. The clamping force should be 6 1/2 to 9 pounds. Make the proper adjustments until the correct clamping force is obtained.

There are two different PC boards used in the PERTEC FD-400-- the 600-191 and the 600-321. These numbers are stamped on the PC board.

Place the unit on its side and attach the scope probes as follows:

	600-191	600-321
A and B probes	T.P. 3 and 5	T.P. 4 and 5
Sync probe (leading edge of index pulse)	T.P. 14	T.P. 10
Ground clip	T.P. 36	T.P. 1

KCACR INCREASES ALTAIR 680B's POTENTIAL

CONTINUED

Error Rate: Relative to quality of recorder and tape, typically less than 1 error in 10^6 bits READ with low noise audio tape.

Power Requirements: +8 Volts unregulated --220MA typical -16 Volts unregulated --50MA typical (less than 3 watts total power)

Requires 1 slot in 680 bus.

Audio Cable Connectors: Mini phone jacks, 3.5MM dia mounted on back panel.

Board Address: F010 - Status & Control F011 - Read & Write Data

Altair Disk Drive Alignment Permits Precise Operation
CONTINUED

Set up your scope for A + B with B inverted and then for EXT SYNC.

The following program, written by Steven Zook from the Computer Store in Santa Monica, California, permits loading and stepping of the head to the desired track under sense switch control.

After loading the program into memory, examine the starting location and run. A15 will load and unload the head while A8 through A14 will control the step functions.

The first step in alignment is to apply the necessary power and control to seek track 0. Then manually twist the stepping screw (shaft) clockwise to the next track in. (this is 1/8 of a full revolution). You should hear the track 0 switch close approximately midway between track 0 and track 1. Upon the verification of track 0, step-in to track 38.

Insert the alignment diskette and load the magnetic head. CAUTION: Do not enable the write or erase modes of operation while a CE diskette is in the drive because alignment data on the diskette may be destroyed. You should now observe the "cats-eye" pattern located at track 38. The desired waveform should be a symmetrical pattern as shown in Figure 2 and 3.

If you notice an improper waveform, twist the stepping screw slightly while you observe the scope pattern to see in which direction the head must move to correct the waveform. Loosen the two 1/4" hex h head mounting screws on the stepper motor approximately 1/8 turn. Place a blunt instrument against the end of the stepper motor and tap the motor sharply while observing the cats-eye pattern. When a symmetrical pattern is achieved (one lobe of the cats-eye being 80% of the other, minimum), tighten the mounting screws snugly.

Step to track 1 and set the oscilloscope horizontal time base to 20 μsec/Div. You should now observe the index-sensor burst shown in Figure 4.

Reinsert the alignment diskette several times to check for constant registration. If the index burst shifts more than 40 μs., the cone/hub mechanism is faulty, or the alignment diskette has too large an opening. Use the average position of the index burst for making the following adjustments.
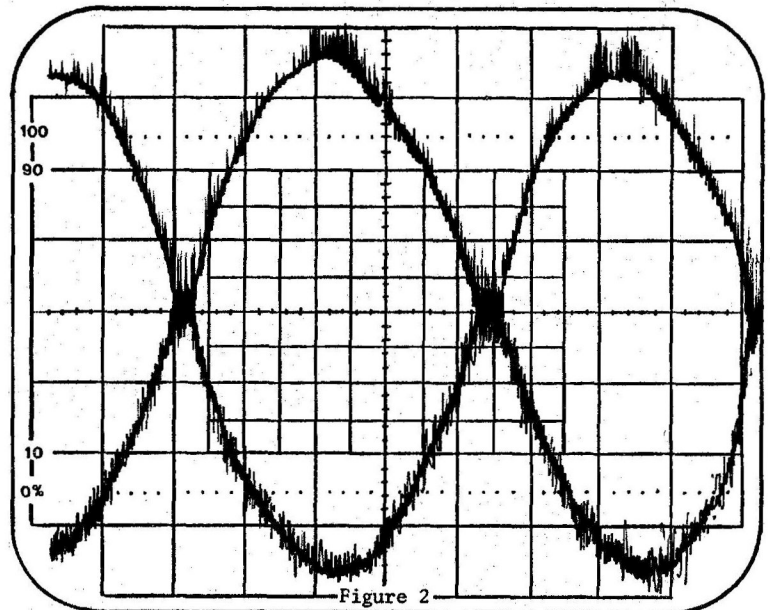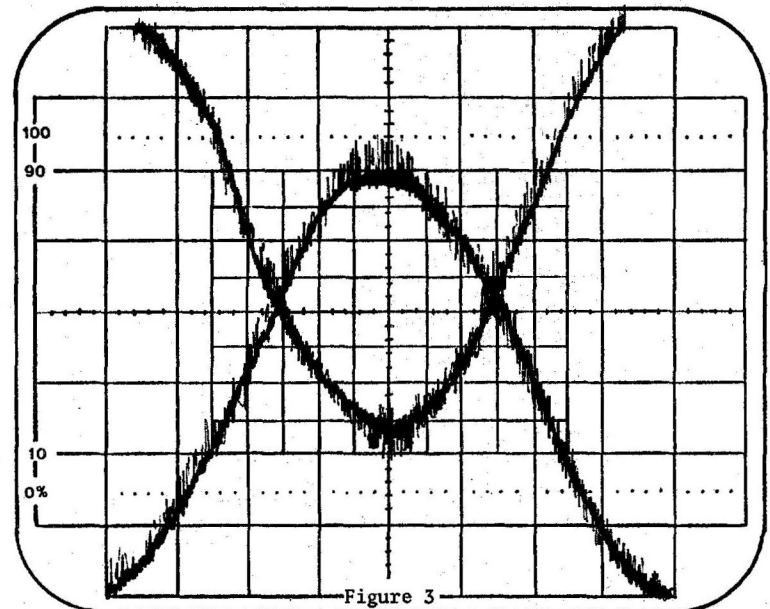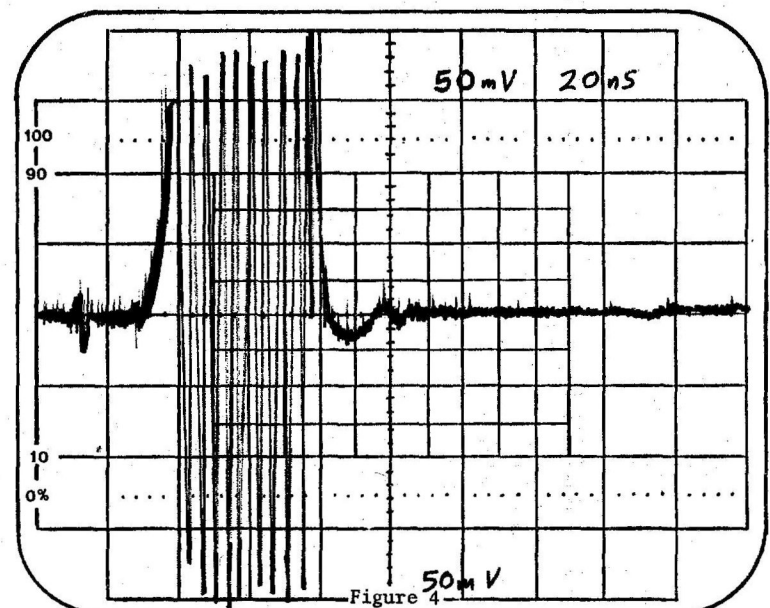
CONTINUED

Figure 2

Figure 3

Figure 4

Sequential Data Files
Best for Storing Routines

By Chuck Vertrees

Once an assembly language routine has been debugged and is in the computer's memory, it's helpful to have a method to save the routine, particularly if it's a long one.

With Altair Disk Extended BASIC, the routine can be stored as a program file that uses explicit POKE statements. But for long routines, this is a very slow, error-prone method. The best way to save a routine is as a sequential data file.

With the two BASIC programs listed below, consecutive memory locations can be stored in a disk data file and restored from that same file. The first program, "SAVE," dumps memory between two locations that you specify onto the disk. The data is stored in a sequential file whose name you must specify. The program allows you to specify the disk upon which you want the file to be saved. Before specifying the locations for saving, it also shows what files are currently on the specified disk.

When you specify a file name, the "SAVE" program adds "I:" to the file name. This is to help identify those files created by the "SAVE" program, which are actually image files.

"SAVE" PROGRAM

```
10 'MEMORY DUMP TO DISK
        WILL SAVE SPECIFIED LOCATIONS OF MEMORY IN SEQUENTIAL FILE
        FOR USE BY THE "RESTORE" PROGRAM.
20 DEFINT A-Z
30 PRINT:PRINT:PRINT
40 PRINT"MEMORY DUMP AND SAVE TO DISK PROGRAM.
50 DN=0
60 PRINT:INPUT"WHICH DISK";DN
70 PRINT:PRINT"HERE ARE THE FILES CURRENTLY ACTIVE ON DISK";DN:PRINT
80 FILESDN
90 PRINT:PRINT:PRINT
100 LINEINPUT"FILE NAME YOU WISH SAVED UNDER ?   ";N$
110 N$="I:"+N$
120 OPEN"O",1,N$,DN
130 PRINT#1,"IMAGEFILE"
140 PRINT
150 INPUT"STARTING MEMORY ADDRESS ";SA
160 INPUT"ENDING MEMORY ADDRESS ";EA
170 PRINT#1,SA,EA
180 PRINT:PRINT"SAVING ........."
190 FORI=0TOEA-SA
200 K=PEEK(SA+I)
210 PRINT#1,K
220 NEXTI
230 CLOSE
240 PRINT:PRINT
250 PRINT"FILE SAVED AS '";N$;"' AND CLOSED."
260 PRINT:PRINT:END
```

Altair Disk Drive Alignment Permits Precise Operation
CONTINUED

Step to track 76 and observe the index sensor burst. This burst must be within ± 20 μsec. of the position of the burst on track 1. If the bursts are not within ± 20 μsec. of each other, position the stepper motor (sideways to bring the burst into alignment. To position the stepper motor, insert a flat bladed screwdriver between the stepper motor frame and chassis. The screwdriver may be used as a lever to move the stepper motor in the desired direction.

Return to track 1 to ascertain that the bursts are within 20 μsec. of each other. If not, repeat the previous procedure, always moving the bursts at track 76 to meet the burst at track 1. Then go back and check the cats-eye and realign it if necessary. Always recheck the cats-eye and bursts when you do any adjustments.

The beginning of the 40 μsec. burst should occur 40 μsec. ± 20

μsec. after the index pulse. To adjust this pattern, loosen the screws retaining the photo-transistor bracket, 1/4 turn and lightly tap the bracket until the proper burst position is obtained. Then retighten the bracket.

Problems may occur when software other than MITS Disk BASIC is used to write data on the diskette. PERTEC has been supplying the FD-400 with trim erase generated internally on the 600-321 PC board in the drive. If the MITS disk controller has a shorter trim erase time constant than the FD-400, step commands will be enabled before the drive is ready. MITS Disk BASIC will automatically relocate the desired track, but other software drivers may have trouble stepping after writing. The correct fix for this problem is to change the jumpers on the 600-321 PC board as follows: Disconnect W3 and install W4. (Refer to drawing #600-320 sheet 4 of the PERTEC FD-400 manual--available through MITS, Part Number 101595, at $10.00 each).

The drive should maintain alignment for at least 6 months under normal operating circumstances.

On the Floppy Disk drive cabinet, we had some complaints concerning ripple on the +5 volt power supply. This problem causes intermittently erratic operation of the disk system and is usually a result of AC line voltage under 115 volts. The problem is corrected by replacing T2 (small transformer) with MITS Part Number 102620, which has more conservative ratings. If you replace this transformer, please return the original for warranty credit. The new transformer may be identified by dual primary windings, which must be parallelled for 110 volt operation. Another fix is to parallel a second 3300 Mf capacitor with the existing filter for the +5 volt supply.

A new policy has been adopted for the shipment of the Altair Disk Drive. The chassis and the PERTEC drive will be shipped in separate boxes to insure proper alignment upon arrival. A change was also made last year concerning the mounting of the disk drive in the chassis. A three-point stance is now used to avoid warping of the drive chassis or any undue stress that may result in misalignment.

Designing Consumer-Peripherals System

By Thomas Durston

The design goals we formulated in March 1975 for the Altair floppy-disk system were essentially the same as those formulated for other Altair products. Striving to keep our approach general at first, we decided to:

- Design the hardware to interface the Altair 8800 computer to currently available floppy-disk drives
- Design the hardware to allow efficient use of software
- Design the system for low cost without sacrificing reliability
- Complete the hardware design in a minimum time
- Design for the simplest circuitry to allow easy troubleshooting
- Create a product that a user can build from a kit
- Use a minimum number of special components
- Design a product that can operate from a variety of ac supply voltages and frequencies.

As a first step toward making these goals more specific, we had to define the system configuration, decide upon the most efficient read/write format and consider the software required to drive the system. After examining our options, we set these more specific design goals:

- Utilize hard-sectored formatting
- Install one drive per cabinet, with provisions for connecting up to 16 drives in a system
- Partition the disk controller into seven major circuit groups.

These groups include addressing circuits for communication with the computer, index/sector circuitry, a Read Data circuit, disk-drive and controller status circuits, a Write Data circuit, a disk-drive-selection circuit and disk-drive function-control circuitry.

ACHIEVING THE GOALS

After we completed this initial design phase, we discovered that the required controller circuitry, which incorporates about 60 TTL ICs, was too dense to fit on one of the 5" x 10" cards used in the Altair computer. So we split the circuit functions--Disk Controller Board One provides address selection and also contains the three circuits that transfer information to the Altair CPU (input instruction), while Disk Controller Board Two handles outputs from the CPU (Fig. 1). Dividing the controller functions this way has simplified troubleshooting in the floppy-disk system.

CONTINUED

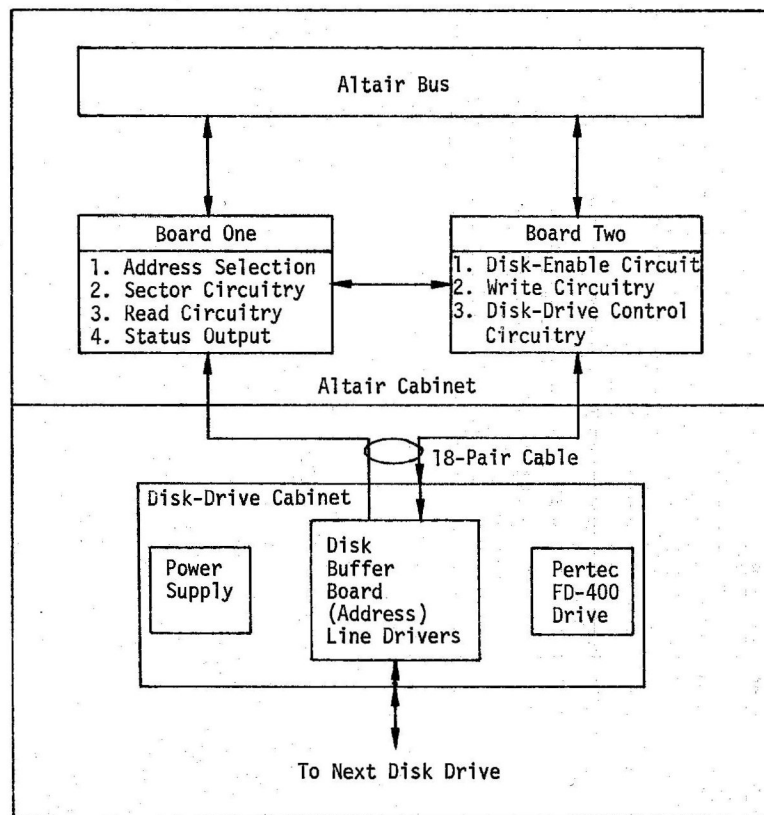## Floppy-Disk System Partitions Function on Two Boards

Figure 1

Sequential Data Files Best for Storing Routines
CONTINUED

Once you have specified (1) a particular disk, (if you don't specify a disk, it assumes disk $\emptyset$), (2) the file name under which you want the memory locations saved, and (3) the starting and ending addresses, the program saves those locations in the data file and closes it.

The "RESTORE" works much the same as the "SAVE" program but in reverse. The setup dialogue for the two programs is the same, except that the "RESTORE" program asks if you want to load the file. This provides an opportunity to stop the actual loading of the file if something is wrong with it. Any answer other than "Y" will cause the file not to be loaded into memory.

As the data is POKED into memory, it is immediately PEEKED back out and compared to the value just POKED. This is to check for bad memory locations. If a bad location is detected, the program will print a message to that effect and then stop. Otherwise, it will acknowledge that the data has been loaded and will stop.

When specifying the name of the file to be loaded, it's not necessary to type the "I:" in front of the file name, as in the "SAVE" program. The "RESTORE" program automatically adds this to each file name.

Note: Both of these programs are written for a CRT. If you do not use a CRT, then you will probably want to eliminate a large portion of the dialogue, because the programs are rather talky.
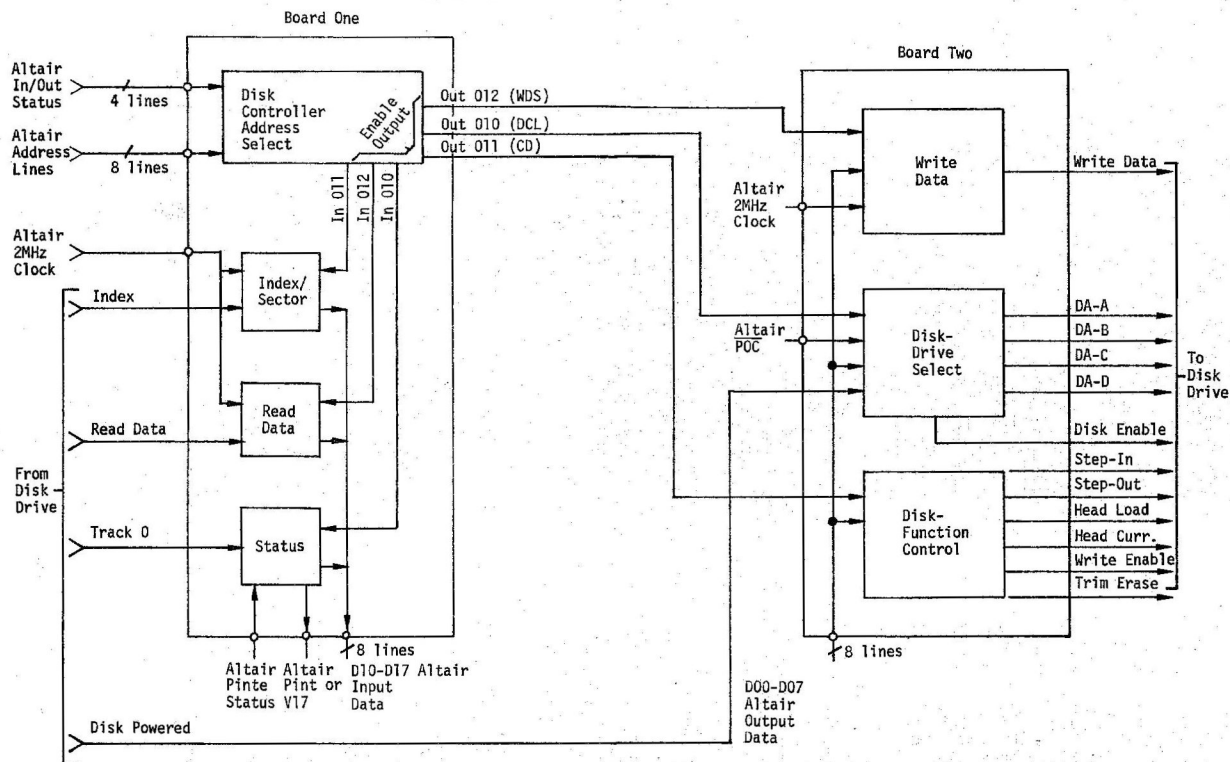
Figure 2

Some of the seven circuit groups (Fig. 2) were easily implemented. For the address selection logic on Board One, we used standard 7400-type gates to decode the system's eight address and four I/O status lines into the lines that enable the six controller circuits. Designing the logic for the index/sector circuitry and the Read Data Circuit was tougher. We used synchronous logic where possible; where timing delays were required, we achieved them through careful application of one-shot multivibrators. We designed the timing circuits in the index/sector decoder to allow a 20% variation in pulse width output, and we used 5% tolerance Mylar capacitors to ensure accuracy and stability. We also bypassed the Vcc supply at each one-shot, using 0.1 μf ceramic disk capacitors, and we located the timing components as close as possible to their respective pins on the IC. The Read Data circuit utilizes the only monostable multivibrator in the disk controller that requires 10% accuracy, and 5% tolerance mica capacitors minimize variations in it. The rest of the circuitry consists of logic connected synchronously to provide the sector count and the read data presented to the data input bus in the computer.

The other input circuitry on Board One is the status circuit, which we also designed as simply as possible. It consists of line drivers with their inputs connected to the various circuits as required by software and their outputs connected to the Altair data input bus. To reduce noise in the system, the +5 V Vcc supply for Board One contains bypass capacitors, and all unused inputs are either grounded or connected to Vcc through 1K pullup resistors.

The same design principles used on Board One apply to Board Two. We made the design of the Write Data circuit on Board Two completely synchronous, including the 9316 counters used to generate the write clock and data timing. This type of circuitry is highly stable and eliminates the ripple through counting noise found in nonsynchronous logic. The disk-drive-select circuitry is uncomplicated; it consists of a 4-bit latch, a flip flop and a one-shot timer. We designed the disk function-control circuit to operate the individual disk drive functions; each function requires at least one timing circuit. As before, we configured the required one-shot timers to allow for worst-case variations.

After investigating interconnect and wiring alternatives, we chose a method in which 0.1" center-pin connectors mate to sockets with crimp or solder pins; the scheme allows a kit builder to assemble typically expensive cables at good savings. For the interconnect wiring, we chose twisted-pair flat cable to provide what we feel is the best noise immunity and signal transfer characteristics.

For a floppy-disk drive, we selected the Pertec FD-400, both for its dc motor and performance characteristics (its dc motor is insensitive to line frequency variations and requires no drive belts) and its price. We designed a power supply to accommodate the floppy's requirements and keep special parts usage and cost to a minimum; to simplify the design and guarantee supply stability we chose 7800-type voltage regulators. The system's heatsinking utilizes aluminum extrusions and a cooling fan; external interconnections occur through DC-37 rectangular connectors, chosen because of availability, reliability and low cost.

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION

By Rich Haber

Learning about microcomputers for the first time requires a great deal of new information. Since the microcomputer field is still in its infancy, adequate literature is often difficult to obtain.

The following list of periodicals, books and computer clubs should help the novice computer enthusiast locate the most up-to-date information.

BYTE
Peterborough, NH 03458
Monthly, $12/year

BYTE, usually a very thick publication, emphasizes hardware, with articles on microcomputer construction and design. Always comprehensive in its approach to any subject, BYTE occasionally devotes an entire issue to a particular topic.

CREATIVE COMPUTING
PO Box 789-M
Morristown, NJ 07960
Bimonthly, Institutional--$15/year, Individual--$8/year, Student--$6/year

CREATIVE COMPUTING describes itself as "the magazine of recreational and educational computing." Although it does give equipment profiles, it is not specifically aimed at the electronic aspect of microcomputers. Written in a rather informal style, CREATIVE COMPUTING includes fiction, games, puzzles, cartoons, book reviews, software and computer art.

KILOBAUD
Peterborough, NH 03458
Monthly, $15/year

KILOBAUD, another new publication, is an offshoot from "73," a popular amateur radio publication. Although KILOBAUD includes both hardware and software articles, it leans more toward the former.

PERSONAL COMPUTING
167 Corey Road
Brookline, MA 02146
Bimonthly, $8/year

PERSONAL COMPUTING, a newcomer to the field, is a very slick magazine that uses many colorful and interesting graphics. It takes a general approach to microcomputers and usually includes fiction articles on the social implications and applications of microcomputers.

Sequential Data Files Best for Storing Routines   CONTINUED

"RESTORE" PROGRAM

```
10 'MEMORY RESTORE FROM DISK
        THIS PROGRAM LOADS MEMORY FROM A SAVED IMAGE FILE CREATED
        BY THE MEMORY "SAVE" PROGRAM
20 DEFINT A-Z
30 CLEAR 300
40 PRINT:PRINT:PRINT"MEMORY RESTORE FROM DISK"
50 DN=0
60 PRINT:INPUT"WHICH DISK";DN
70 PRINT"HERE ARE THE FILES CURENTLY ON DISK";DN:PRINT
80 FILESDN
90 PRINT:PRINT:LINEINPUT"WHICH IMAGE FILE DO YOU WISH TO LOAD ?   ";N$
100 N$="I:"+N$
110 OPEN"I",#1,N$,DN
120 LINEINPUT#1,I$
130 IF I$<>"IMAGEFILE" THEN PRINT:PRINT"NOT AN IMAGE FILE":PRINT:END
140 INPUT#1,SA,EA
150 PRINT:PRINT:PRINT"STARTING MEM ADDRESS IS",SA
160 PRINT"ENDING MEM ADDRESS IS",EA
170 PRINT:LINEINPUT"DO YOU WISH THE FILE TO BE LOADED (Y OR N) ? ";M$
180 IF LEFT$(M$,1)<>"Y" THEN PRINT:PRINT"FILE NOT LOADED":PRINT:END
190 PRINT:PRINT"LOADING..........":PRINT
200 FORI=0TOEA-SA
210 INPUT#1,K
220 POKESA+I,K
230 KK=PEEK(SA+I)
240 IF KK<>K THEN PRINT"MEMORY ERROR AT";SA+I:PRINT:END
250 NEXTI
260 PRINT:PRINT"ALL THROUGH:   LOAD OK."
270 CLOSE
280 PRINT:END
```

Floppy-Disk System Partitions Function on Two Boards
CONTINUED

Figure 3

The resulting floppy-disk system (Fig 3) can store over 300K bytes/diskette and has an access time of less than one second. It usually uses Altair Disk Basic software, which resides in the lower 20K of memory and provides disk utilization routines. The system's two controller cards plug into the computer's bus; all control, status and data I/O goes through three I/O ports dedicated to disk control.

Altair Computer Reproduces Voice: Complex Waveforms Made Simple

By Bill Kuhn

An Altair 8800a doesn't look much like a tape recorder, and it usually doesn't function much like one either. But that didn't stop me from trying to record my voice on my Altair computer system.

First, I plugged 64K of memory and an Altair 88-AD/DA Converter into my chassis. Then I connected a microphone and microphone preamp to an analog input, and an amplifier and loudspeaker to the output of the Altair 88-AD/DA. Next, I connected a push button to one of the CA1 handshake lines, and toggled in 130_8 bytes of initialization and program.

Pressing the button to start the "record" section of the program, I spoke into the microphone: "Altair 8800," I said as I watched the address lights cycle through the full 64K. With growing anticipation, I pressed the button again to start the "playback" section of the program. Squeeeek! Derdul! Hummmmmm! Bzzzzt! That didn't even vaguely resemble my voice. So I grounded the Altair 88-AD/DA input and tried again. Squeeeek, hummmmm!

I finally looked back at my program and discovered an error. After correcting the error, I tried recording my voice once again. This time, the computer played back: "Altair 8800." "Neat!," I said. "Neat!," replied my computer.

Obviously, there are less expensive devices on the market other than the Altair 8800 computer for recording voice. So why the big deal? My experiment illustrates that complex waveforms, like the sound of my voice, can be acquired, digitized, stored, retrieved and output again in analog form. Since this complex voice waveform can be stored, it can be analyzed or processed by the computer. If the computer can output such a complex waveform, any type of waveform that can be written in an equation can be generated at almost any speed.

The software included in this article causes the Altair computer and the Altair 88-AD/DA to sample the incoming analog signal at approximately 32 thousand times per second. This sample rate will fill the memory of a full 64K machine in about two seconds. However, it is faster than necessary for voice intelligibility.
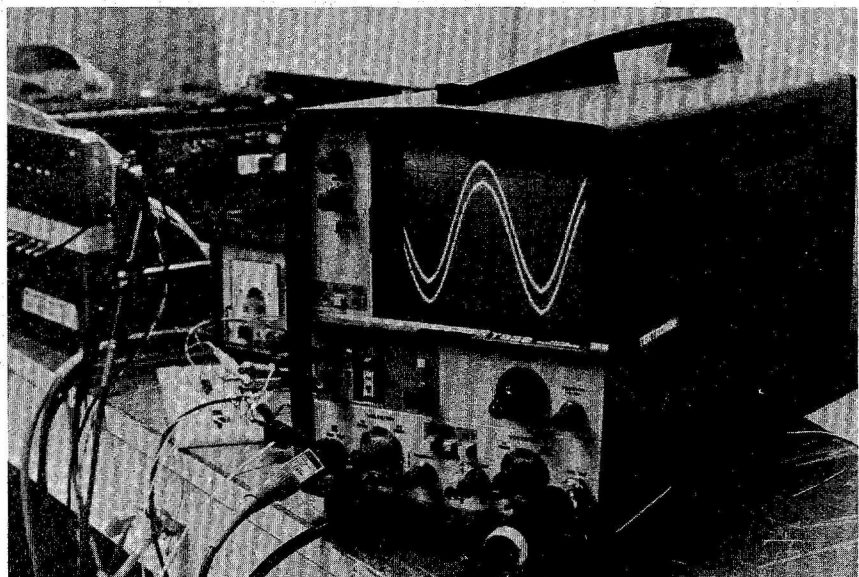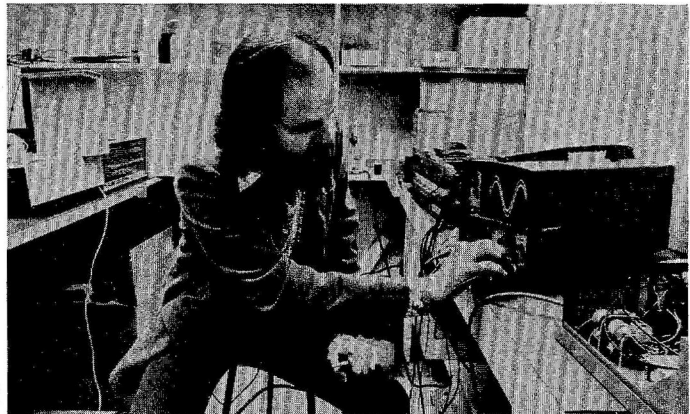
SCCS INTERFACE
Southern California Computer Society
Box 54751
Los Angeles, CA 90054
Monthly, $10 membership includes
year's subscription

SCCS INTERFACE is the official
publication of the Southern
California Computer Society.
It's a small but professional
magazine with about six general
interest articles geared toward
the beginner.

INTERFACE AGE
13913 Artesia Blvd.
Cerritos, CA 90701
Monthly, $10/year

INTERFACE AGE describes itself
as a magazine about "micro-
computing for home and small
business." The articles are
very detailed and technically
oriented. But they provide
important information on many
new developments in hardware
and software.

Books on Microcomputer Design and
Operation:

INTRODUCTION TO MICROCOMPUTERS,
VOLUMES I AND II
Adam Osborne
Osborne & Associates
304 pp., $7.50 each

Detailed explanation of micro-
computer architecture. Volume
I is generalized. II deals
with real microprocessors.

MICROPROCESSORS AND MICROCOMPUTERS
Branko Soucek
John Wiley & Sons
607 pp., $23

A very comprehensive introduc-
tion to the field. Covers
binary system, digital logic,
machine language instructions,
interfacing and representative
microprocessors. Not over-
priced, considering its scope.

INTRODUCTION TO MICROCOMPUTERS AND
MICROPROCESSORS
Barna & Porat
John Wiley & Sons
108 pp., $10.50

A textbook. Methodical approach
to hardware and software.

MICROCOMPUTER PRIMER
Waite & Pardee
Howard W. Sams
224 pp., $7.95

Good introduction to computer
hardware, architecture and
peripherals.

Altair Disk Drive Alignment Permits Precise Operation
CONTINUED

DISK EXERCISER PROGRAM

ADDRESS	CODE	MNEMONIC
000	333	IN (CHANNEL)
001	377	
002	346	ANI (DATA)
003	017	
004	127	MOV D,A
005	172	MOV A,D
006	323	OUT (CHANNEL)
007	010	
010	333	IN (CHANNEL)
011	010	
012	074	INR A
013	312	JZ / 000005
014	005	
015	000	
016	333	IN (CHANNEL)
017	010	
020	346	ANI (DATA)
021	002	
022	302	JNZ / 000016
023	016	
024	000	
025	076	MVI A,/ 002
026	002	
027	323	OUT (CHANNEL)
030	011	
031	333	IN (CHANNEL)
032	010	
033	346	ANI (DATA)
034	100	
035	302	JNZ / 000016
036	016	
037	000	
040	006	MVI B,/ 000
041	000	
042	333	IN (CHANNEL)
043	377	
044	007	RLC
045	267	ORA A
046	037	RAR
047	117	MOV C,A
050	076	MVI A,/004
051	004	
052	322	JNC /000057
053	057	
054	000	
055	076	MVI A,/ 010
056	010	
057	323	OUT (CHANNEL)
060	011	
061	333	IN (CHANNEL)
062	010	
063	074	INR A
064	312	JZ /000005
065	005	
066	000	
067	075	DCR A
070	346	ANI (DATA)

CONTINUED

Altair Computer Reproduces Voice: Complex Waveforms Made Simple

CONTINUED

In general, for A to D conversion of this type, the input signal should be sampled at about three or four times the maximum frequency of interest. Voice is quite recognizable and intelligible with a 3KHz maximum frequency, so a sample rate of 10KHz might be a good compromise. Since most people's ears are sensitive to 10KHz, a lowpass filter with a 3 dB point of 3KHz should be used. This filter limits the amount of sample frequency that will come through.

In the playback part of the program, read the sense switches to determine the playback rate. 002_8 gives nearly one-to-one playback. Larger numbers slow down the playback, causing some unusual effects.

The schematics of the hardware and a listing of the software I used for the voice digitizing experiment follow.

Initialization (for Voice Digitizing Experiment)

Location	Contents	Mnemonic	Comments
000	257	XRA Acc.	Zero Accumulator
1	323		
2	100		
3	323		
4	101		
5	323		
6	102		
7	323		
010	104		
1	323		
2	106		
3	057	CMA	All 1's to Acc.
4	323		
5	103		
6	323		
7	105		
020	323		
1	107		
2	076	MVI Acc.	Load Accumulator Immediate
3	054	DATA	
4	323		
5	100		
6	323		
7	102		
030	323		
1	104		
2	323		
3	106		

Altair Disk Drive Alignment Permits Precise Operation

CONTINUED

071	002	
072	302	JNZ / 000061
073	061	
074	000	
075	171	MOV A,C
076	376	CPI (DATA)
077	115	
100	322	JNC / 000042
101	042	
102	000	
103	270	CMP B
104	312	JZ / 000042
105	042	
106	000	
107	332	JC / 000122
110	122	
111	000	
112	076	MVI A,/001
113	001	
114	323	OUT (CHANNEL)
115	011	
116	004	INR B
117	303	JMP / 000061
120	061	
121	000	
122	076	MVI A,/002
123	002	
124	323	OUT (CHANNEL)
125	011	
126	005	DCR B
127	303	JMP / 000061
130	061	
131	000	

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION   CONTINUED

HOW TO BUY AND USE MINI AND MICRO-COMPUTERS
William Barden, Jr.
Howard W. Sams
240 pp., $9.95

Explains and compares various computers and peripherals. Not suggested as a first book.

BUGBOOK I, II & III
Larsen, Rony & Titus
E & L Instruments, Inc.

A very comprehensive book designed to help the user learn by doing.

UNDERSTANDING DIGITAL COMPUTERS
Ronald M. Benrey
Hayden Publishing Co., Inc.
166 pp.,

This is an old book, but most of the information is still relevant. Written in an easy-to-understand style, it covers the binary system, Boolean algebra, logic design, machine language programming and memory devices.
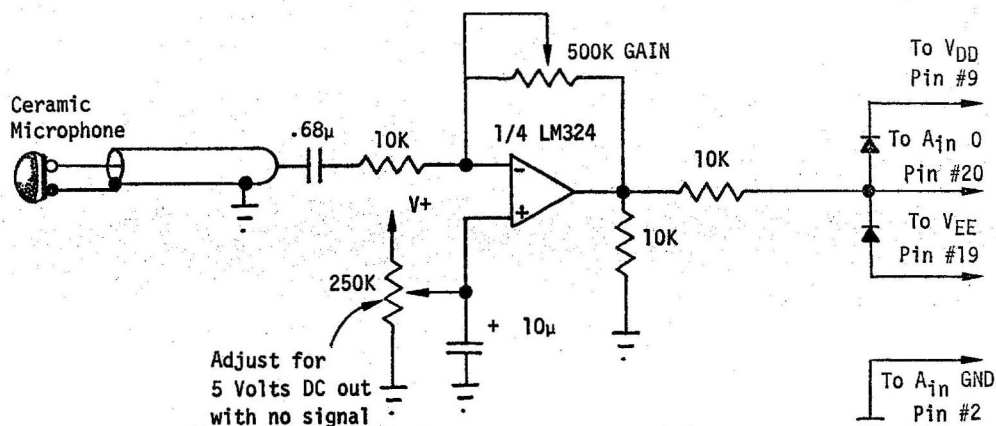
Program for Voice Digitizing Experiment

Loc.	Contents			Loc.	Contents		
040	333 IN ←		Wait for	100	027 RAL		Wait for
1	104		Status	1	322 JNC		Status
2	027 RAL		Start function	2	076		Clear
3	322 JNC			3	000		
4	040		Push Button	4	333		Clear
5	000			5	105		Status
6	333 IN		Clear	6	041 LXI-HL ←		Load Start
7	105		Status	7	001		Address
050	041 LXI-HL		Load Start	110	001		
1	000		Address	1	333 IN ←		Read S.S.
2	001			2	377		Setup Counter
3	001 LXI-BC		Load Increment	3	075 DCR ←		Decrement
4	001			4	302 JNZ		Counter
5	000			5	113		(Time Out)
6	067 SC		Clear	6	000		
7	077 CC		Carry	7	011 DAD		Increment Address
060	257 XRA Acc ←		Zero Acc.	120	176 MOV Mem→		
1	323		Start		Acc.		
2	103		Conversion	1	323 OUT		Output D to A
3	011 DAD BE+			2	105		
	HL→HL		Increment Addr.	3	322 JNC		
4	332 JC		Jump on	4	111		
5	076		Mem. full	5	000		
6	000			6	303		
7	000 NOP			7	106		
070	333 IN		Read	130	000		
1	101		A/D data				
2	167 MOV Acc→		Store				
	Mem						
3	303						
4	060						
5	000						
6	333						
7	104						

Ceramic Microphone — .68μ — 10K — 1/4 LM324 — 500K GAIN — 10K — 10K

V+ 250K — Adjust for 5 Volts DC out with no signal — + 10μ

To V_DD Pin #9
To A_in 0 Pin #20
To V_EE Pin #19
To A_in GND Pin #2

Pin #'s at right are for DB 25-pin connector from 88-AD/DA

+5V — 2.2K — 0.1μ

To CA1 pin #17
To System GND Pin #6
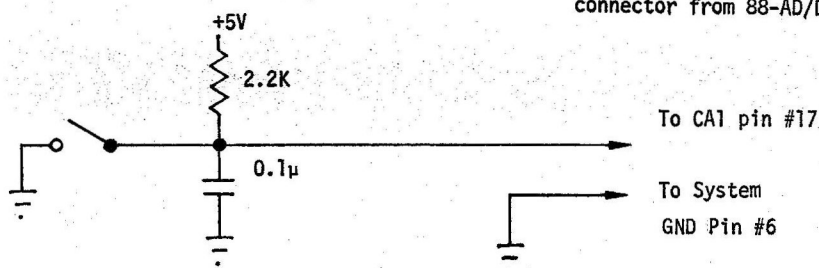
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ACR ALIGNMENT AIDS IN TROUBLESHOOTING

By Rich Haber

Second article in a three-part series on the theory of operation and repair of Altair ACR cards.

In this second portion of the series, I'll discuss alignment of the ACR modem, saving programs and some ACR troubleshooting hints.

But before attempting any of the following repair procedures, make sure that you fully understand the ACR theory of operation (see pp. 14-20, March, C.N.).

If the ACR isn't functioning properly (BASIC won't load or programs can't be recorded), the ACR alignment should be checked first.

Alignment of the Modem

Every cassette player and tape has slightly different speed and head specifications. So, the ACR must be realigned whenever the deck or tape is changed. One method of alignment is explained below.

1. Plug ACR into chassis, on top of an extender card (SIOB side to your right), if available.

2. Insert mini-plug into earphone (plug-in) jack and the other end into the ACR cable going to pin 2.

3. Plug ACR cable into the ACR board. Pin 4 is ground.

4. Insert test side of BASIC tape into player and rewind.

5. Turn on computer. Reset and deposit the following program.

   333
   007 (window program which displays input data on the data lights)

   Examine zero, then single step twice.

6. Attach the clip-on probe of the scope to pin 10 of the ACR Molex connector (pin furthest from you). This is the output of the demodulator.

7. Set scope for 2v/cm and 1 msec/cm.

8. Play tape with volume set midway or lower.

9. Adjust R29 (pot furthest from you) for an equal duty cycle. Each alternation should be about 3.2 msec. Data lights should display 1 25's (01 010 101).

10. Put scope probe into the test point hole (on Modem side of board near R29) labelled TP. Set scope for 4v/cm and 2 msec/cm.

11. Turn tape deck gain low.

12. Adjust the next port towards you for maximum gain and flat positive peaks (as shown below).

13. Adjust the port closest to you to do the same for the negative peaks and turn tape deck gain back up.

14. Advance the tape to the second test pattern (175's or 256's) and check for a stable display on the data lights.

This completes the alignment procedure. Now make sure that you can load BASIC.

How to Load BASIC

1. Deposit ACR bootstrap. If you have a multiboot PROM card, merely address the starting location of the ACR boot.

2. Install tape (BASIC side up) and rewind to beginning.

3. If you have loaded the boot by hand, examine address 000012 and single step twice. This is the window program and will allow you to see the 256's written on tape before BASIC starts. If you are using a PROM bootstrap, find 333 and 007 on the PROM, then single step twice from 333.

4. Start the tape.

5. After a few seconds, the data lights should show a stable display of 256 (10 101 110).

6. Quickly examine address 0.

7. Lift switch A15. If you are using a 2SIO for an I/O board, lift A11.

8. Hit RUN.

9. After about 20 seconds, the address lights will "jump." Address lights A3, A4 and A6 should go out.

10. After a few minutes, the terminal should say "memory size?"

11. Hit the return key on the terminal.

12. It will then ask what functions you want: "Want Sin, Cos, Atan?"

13. Answer Y for yes; N for no.

14. When it prints "OK," you are ready to write a test program.

If the terminal starts printing out C's (cccccc, etc.) while it is loading, a "checksum error" is indicated. This is an error in transmission of data, possibly a bad tape. If it prints out M's (mmmmm, etc.), a memory error is indicated. One of your memory boards is probably bad.

Altair Computer Reproduces Voice: Complex Waveforms Made Simple
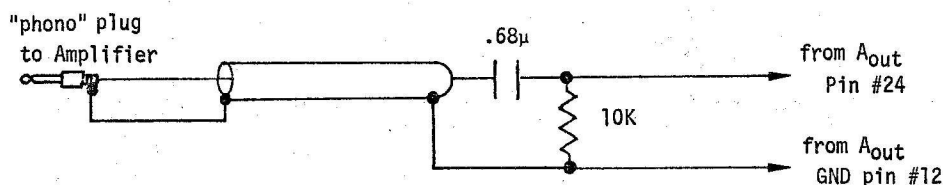
CONTINUED

ACR ALIGNMENT AIDS IN TROUBLESHOOTING
CONTINUED

The next step is to make sure programs can be saved.

Saving Programs through the ACR

The ACR can be used to store programs by utilizing the CSAVE command. (Note: Only 8K and Extended BASIC have the CSAVE capability.) When checking out any ACR, the following procedure should be done several times.

1. Write a simple test program.

   Example:

       10 Print "ABCDEFGHIJK . . ."
       20 GOTO 10

2. Run the program to see if it works.

3. Type "Control C" to stop the program.

4. Type C SAVE A (any label can be used).

5. Connect the cable from the record-out jack of the ACR cable to "MIC" or "record-in" jack of the tape deck.

6. Install a blank cassette in the ACR. If there are two holes in the back edge of the cassette, they should be covered with tape. (This system prevents accidental erasures of BASIC.)

7. Rewind the tape.

8. Press play and record. Let it run past the leader or about 15 seconds.

9. Press the return key on the terminal.

10. When the program has been stored, it will print "OK."

11. Reconnect the cable so that the earphone-out on deck is connected to play-in on ACR.

12. Type NEW on the terminal and hit return. This will erase the program from memory.

13. Rewind the tape.

14. Type CLOAD A (or whatever you have called your program) and hit RETURN.

15. Play the tape.

16. The terminal should respond "OK."

17. Type RUN and hit return.

18. Your program should run on the terminal.

19. Repeat this procedure several times.

If you type CLOAD (A), hit return and nothing happens; the computer either did not save or load properly. It will wait indefinitely for A to load. To reset the computer, stop it (examine ∅∅∅,∅∅∅) and hit run. Check for errors and repeat this procedure several times.

ACR Troubleshooting Hints

1. 3.2 and higher versions of BASIC incorporate a larger frequency swing in the data stored on the cassettes than earlier versions. All the older ACR's should be modified to correctly interpret these cassettes. See the list of modifications at the end of this article.) Check to see that these modifications are correct on your boards. A revised board will usually work with 3.1 BASIC, but an unmodified board will not work at all with 3.2 or higher versions of BASIC.

2. If you have trouble getting a stable 125 on the data lights while running a test tape, check out R29, which may have collected dirt inside. Ohm it out over the entire range to see if it has a smooth response. Check the 5 µf capacitor for leakage.

3. If you are not receiving any data on the data lights after entering a window program, check the following:

   a. regulated voltages

   b. Baud rate--Look at pin 40 of the UART for a negative going 2.3 - 3.0 microsecond pulse every 208 microseconds.

   c. Play 125's from the test tape and check pin 8 of the XR-210 for a good square wave output (-12v to +5v). If there is no output, go to the test point labelled TP and look for a 14v p-p fm signal. By signal tracing around these points, you should be able to isolate a failure. If the problem is centered around the XR-210, refer to the table of waveforms in the ACR manual.

   d. If you have good output from the XR-210 and good continuity to pin 20 of the UART (IC M on the SIOB side), refer to the SIO section of this article.

   e. If you have good input to the XR-210 and bad output, check component values, especially C15, 16 and 17. If you still have problems, the XR-210 might be bad.

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION CONTINUED

Machine Language Programming Books:

SOFTWARE DESIGN FOR MICROPROCESSORS
Wester & Simpson
Available from Creative Computing
350 pp., $12.95

   Detailed explanation of machine and assembly language programming for microprocessors.

PRACTICAL MICROCOMPUTER PROGRAMMING:
THE INTEL 8080
Walt Weller
Northern Technology Books
$21.95, pp.

   Reviewed in December issue of C.N. Application oriented, includes many examples.

8080 PROGRAMMING FOR LOGIC DESIGN
6800 PROGRAMMING FOR LOGIC DESIGN
Adam Osborne
Osborne & Associates

   Sequels to his earlier volumes. Programming microprocessors for dedicated logic applications. Not for the beginner.

Books on BASIC Programming:

   A large number of books on BASIC are available at college and technical book stores. THE BEST OF CREATIVE COMPUTING, Volume 1 (described later) has an article which reviews 21 different books on BASIC. I will mention just a few here.

BASIC
Albrecht, Finkel & Brown
John Wiley & Sons
325 pp., $3.95

   An easy-to-understand programmed introduction to BASIC. Does not cover advanced BASIC.

BASIC BASIC AND ADVANCED BASIC
James S. Coan
Hayden Book Co.
256 pp., 186 pp. and $7.95, $6.95, respectively

   A two-volume set that covers BASIC in detail.

BASIC PROGRAMMING
Kemeny & Kurtz
John Wiley & Sons
150 pp., $7.75

   Written by the authors of the BASIC language, this book is considered one of the best texts available.

4. If you cannot save programs:

    a. On the bottom of the modem there are a number of holes for interconnection wires to the SIOB. The second hole from the right (labelled GND) and the third from the right should both have wires going to the ground connection (pin 4) of the 10-pin molex plug. Check this connection.

    b. Deposit and run the following program:

333	input data to accumu-
377	lator from sense switches
323	output accumulator
007	to channel 7 (ACR data channel)
303	jump
000	to
000	address zero

        This program continually outputs data from sense switches A15-A8 to the modulator section of the modem. With this program running, you can signal trace the circuit.

1. Check IC H, pin 8, for a square wave output. You should be able to modulate the output by changing the sense switch patterns.

2. Check point R0 if there is an output at H8. You should see a modulated triangular wave. This is a very weak signal, approximately 100 mv. Note that R50 should be 22K ohm and not 220K ohm, as shown on the modem board schematic. (See ACR manual-- modem board section.) R50 is a voltage divider and integrating circuit. You should be feeding into a high impedance MIC input, which demands a low level input.

3. If there is no output, check for a 2 MHz input to J2, K2 and E14. If there is no 2 MHz input, check for a low at G11. Do you have continuity from G12 to S$\emptyset$ on the SIOB side? Are ICs J, K and E dividing the signal?

Proper Strapping of the SIOB Card:

1. The ACR should be at channels 6 and 7. Therefore, look at the address straps at left center. I1 should be connected to A1, I2 should be at A2 and all others should be strapped low.

    $A2 = 2^2 = 4$

    $A1 = 2^1 = \dfrac{2}{6}$

2. The ACR operates at 300 baud. Notice the straps at the bottom right corner of the board. The diagram below shows the correct connections for a Rev. 1 SIOB board.
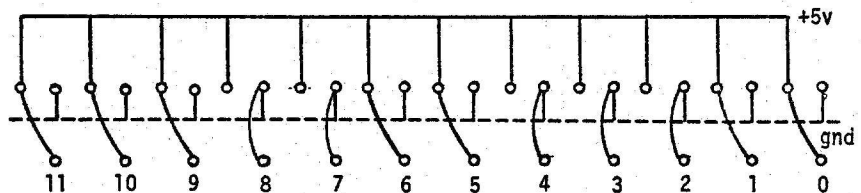
3. The following jumpers should be installed on the board:

    -v to -v
    0 to 0
    I to I
    C to C
    PC to PC

    The interrupt jumper (INT) should not be connected.

4. On the right side of IC M five jumpers should be connected as shown at right.

Altair AD/DA Subsystem Reads and Generates Analog Signals

By Bill Kuhn

88-AD/DA: Analog I/O for 8800 Series

With the Altair 88-AD/DA, the Altair 8800 series can read or measure voltages and can also generate them to 8-bit accuracy.

The new 88-AD/DA Converter is an analog I/O subsystem for the Altair 8800 series computers. The input (A to D) section of the board features an 8-channel Analog Multiplexer, a Sample and Hold Amplifier and an 8-bit resolution Analog to Digital Converter. The 8-channel MUX allows acquisition of analog data from eight different sources. The sample and hold allow accurate digitization of rapidly changing voltages.

The Output section (D to A) consists of two 8-bit resolution D to A converters. The voltage range of both the input and output sections is nominally 0-10VDC.

What is D to A Conversion?

Digital to Analog Conversion is the process of generating an analog quantity (usually voltage or current) from a digital (usually binary) number. The analog output is usually directly proportional to the digital numbers.

The D to A converters on the 88-AD/DA board system are the "switched binary current source" type. (See Figure #1.) With the eight current sources, there are 256 unique combinations of current possible at I_{in}. These range from 0 to $\frac{255}{256} I_{ref}$. These currents at I_{in} are connected to current-to-voltage converters:
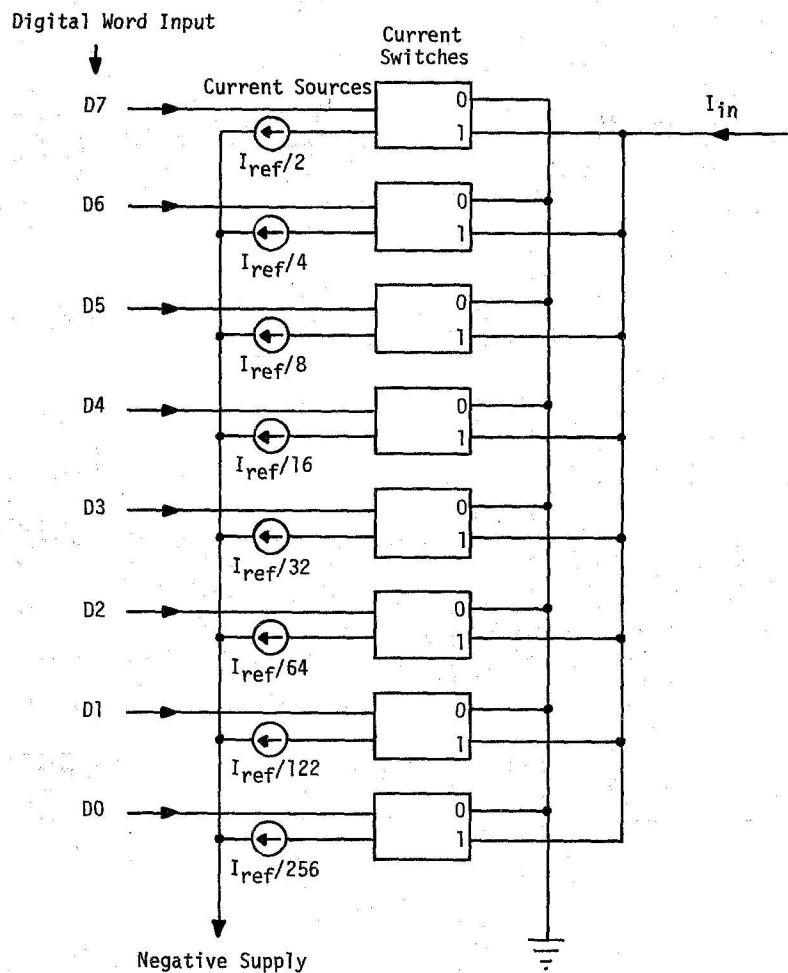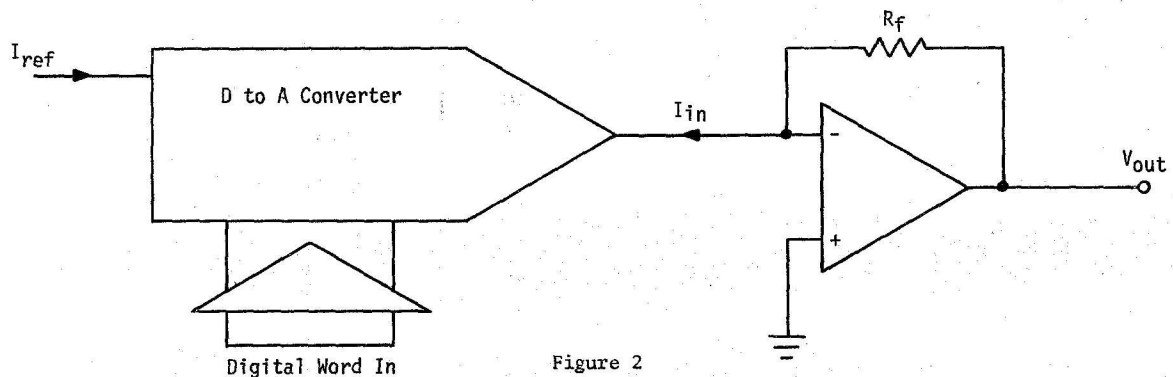

Figure 1

Figure 2

Altair AD/DA Subsystem
Reads and Generates Analog Signals
CONTINUED

The current-to-voltage converter produces a voltage at its output equal to I_{in} x R_f. The I_{ref} used for the 88-DA/AD is equal to 2MA and the R_f = 5K ohms, so the range of output supplied is from 0 to 9.961V = $(\frac{255}{256}$ X $5X10^3$ X 2 X $10^{-3})$. Nominally, this is called 0 to 10 volt output. This output is available in 256 steps of 39 millivolts each. So if the computer outputs a 200 octal to the D to A converter section of the board, an output of 5 volts results from the D to A converter.

For example, 377_8 gives 9.961V, 000_8 gives 0 volts, 001 octal gives .039V, etc.

What is A to D Conversion?

A to D Conversion is the process of generating a number (binary, octal, decimal or whatever) to represent an observed analog quantity. When you look at the position of the pointer on a voltmeter and interpret it as indicating a certain number of volts, you have performed an analog to digital conversion.

The A to D converter section of the 88-AD/DA is a "Successive Approximation" type. (See Figure #3.)

As previously described, a digital to analog converter is used. But this time it isn't connected to a current to voltage converter. Instead, the input current is connected to a node where a resistor-to-ground, a resistor from the Input voltage (voltage to be measured) and the input-to-a-voltage comparator meet. When the I_{in} (current out of the node) of the DAC and the current into the node from V_{in} through R_{in} are equal, there is no current in R_s. So the voltage of the node (referred to ground) is 0.

When a voltage is present, the Successive Approximation converter tries to bring that voltage as near zero as possible, without going below it. It does this by turning on the currents in the DAC (starting with the largest) in succession, testing the output of the comparator to see if it went below zero, leaving the current on if not and turning it off if it does go below zero. When all bits have been checked, the remaining digital word represents the nearest approximation possible of the analog quantity with that converter. At this point the converter gives out a signal called "Conversion Complete," which signals the computer that data is stable and may be read.

The Altair 88-AD/DA user's manual explains in much more detail the software and hardware arrangements necessary to use the board. It also covers circuit theory, application information and trouble-shooting.

Table 3-1 shows the cable connections available from the 88-AD/DA board.

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION   CONTINUED

Specialized Books on Digital Electronics:

TTL COOKBOOK
Don Lancaster
Howard W. Sams
335 pp., $8.95

Excellent book on designing TTL (transistor-transistor logic) circuits. Some previous knowledge of solid state electronics is needed.

MOS DIGITAL ICS
George Flynn
Howard W. Sams
176 pp., $5.95

Covers the theory and design of MOS chips--CMOS, NMOS & PMOS. Shows internal structure of chips and how they are used in circuits.

DIGITAL LOGIC CIRCUITS
Sol Libes
Hayden Book Co.
184 pp., $6.95

Explains how logic circuits work and how they are used. Some previous knowledge of semi-conductor theory is needed.

DIGITAL TROUBLESHOOTING
Richard Gasperini
Hayden Book Co.
$9.95

A well-illustrated guide to digital troubleshooting for the beginner.

TV TYPEWRITER COOKBOOK
Don Lancaster
Howard W. Sams
256 pp., $9.95

Covers how to interface your computer to a TV set for use as a terminal. Knowledge of electronics is needed.

| Table 3-1. Cable Connection		24-Pin Male Connector (P1)	25-Pin Female Connector (DB)
Analog Input Lines	AI0	18	20
	AI1	22	16
	AI2	23	15
	AI3	17	21
	AI4	3	4
	AI5	7	8
	AI6	4	5
	AI7	6	7
	GND	1	2
Control (Handshake) Lines PIA-U System	CB2	20	18
	CB1	2	3
	CA2	9	10
	GND	5	6
	VCD	8	9
	VEE	19	19
Analog Output Lines	GND	10	11
	GND	11	12
	GND	12	13
	A_{AOUT}	14	24
	A_{BOUT}	13	25
Control (Handshake) Lines PIA-T	CA1	21	17
	CA2	15	23
	CB1	24	14
	CB2	16	22

The table below shows the
addressing of the 88-AD/DA board.

Control/Status Register

Address	A Bit 2	B Bit 2	
Base + 0	X	NA	A/D Control/Status Register A
Base + 1	0	NA	Data Direction Register A
Base + 1	1	NA	A/D Data
Base + 2	NA	X	MUX Control/Status Register B
Base + 3	NA	0	Data Direction Register B
Base + 3	NA	1	MUX and Sequence Control Word
Base + 4	X	NA	D/A Control/Status Register A
Base + 5	0	NA	Data Direction Register A
Base + 5	1	NA	D/A Data A
Base + 6	NA	X	D/A Control/Status Register B
Base + 7	NA	0	Data Direction Register B
Base + 7	NA	1	D/A Data B

Figure 3
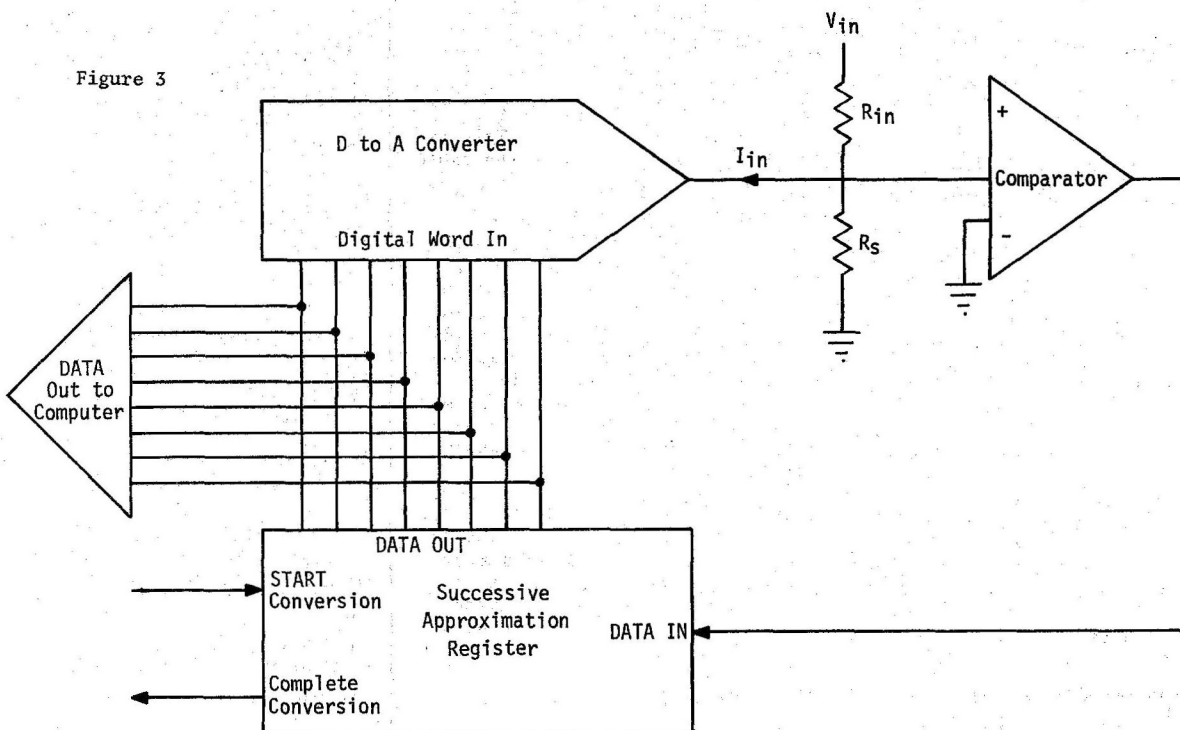
X=Don't Care
NA=Not Applicable

Hardware Applications

There are many potential appli-
cations for the Altair 88-AD/DA
Converter. Just a few general input
and output applications are listed
below.

Inputs:

1. Joysticks (games, remote control,
   computer graphics)

2. Pressure Transducers

3. Temperature Transducers

4. Linear Position Transducers

5. Light Sensors

6. Frequency Sensors (using fre-
   quency to voltage conversion)

7. Modems (modulation/demodulation,
   for computer communication over
   telephone circuits)

8. Various Instruments

9. Magnetic Tapes (input any
   recorded signals)

10. General Purpose Amplifiers

11. Instrumentation Amplifier (bio-
    medical, chemical, circuit analy-
    sis, acoustic analysis)

12. Inertial Devices (gyros, etc.)

Outputs:

1. Oscilloscopes

2. Magnetic Recorders

3. X-Y Recorders

4. Data Terminals

5. Meters

6. Printers

7. Motors

8. Plotters

9. Instruments

10. Heaters

11. Music Synthesizers (voltage control oscillator, voltage control amplifiers, direct wave synthesis, voltage control filters)

12. Voltage Programmable Power Supplies

13. Modems

14. Servos (as in robots, etc.)

15. Filters

Specific Applications:

1. Vector Graphics

The dual digital-to-analog outputs of the 88-AD/DA Converter make vector graphics possible. The general scheme for vector graphics is to generate a serial table in memory with successive points of a figure to be represented on an oscilloscope screen. The coordinates in this table are stored in an area of memory designated by the user/programmer as a "position table." These points are output in succession to the oscilloscope via the Digital-to-Analog Converter. Due to the short persistance of the phosphor on the oscilloscope screen, this position table must be continuously re-output so that the image is continually rewritten. Otherwise, only a brief image will flash on the screen.

To produce lines connecting the points on the oscilloscope screen, the value of the feedback capacitor across the output Operational Amplifiers should be increased. This increases the effective slew rate of the D to A Converter. A good starting point is .001 μf., but the actual value should be determined empirically.

The same four-bit digital resolution generates better visual resolution with vector graphics than block graphics, and vector graphics will generally require less memory to store the image. For example, Figure 4 shows that a circle drawn with vector graphics appears much more like a circle than the circle drawn with block graphics. Both graphics are represented at the same four-bit digital resolution.

A specific application of vector graphics is a free-hand drawing using a joystick. This application requires a joystick with X and Y coordinate outputs. The full scale output should be adjusted for a 0 to 10 volt operating range. The full scale deflection for each axis of the oscilloscope should also be adjusted for 0 to 10 volt input.

To be able to view the figure while it is being generated, the two steps of acquiring the data from the joystick and displaying the table must be multiplexed. This is accomplished by outputting the table once after acquiring each new point.

To avoid filling the memory with redundant information when the joystick is stationary, the program should test each input location to see if it is different from the last character stored. Further reduction of memory used can be accomplished by masking off bits at the least significant end of the position word (the new position data must be different from the old by some amount before it is stored). Masking off 2 bits yields 6 bits of resolution, which should be acceptable for most graphic use. Since two coordinates are involved, the amount of memory used for the position table is directly proportional to the square of the resolution (8 bits - 6 bits

= 2 bits = 4 binary counts, $4^2 = 16$). Thus, an 8-bit system uses 16 times as much memory as a 6-bit system. So, by masking off 2 bits, the system uses 1/16 as much memory as with the full 8 bits.

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION CONTINUED

MICROCOMPUTER DICTIONARY AND GUIDE
Charles J. Sipple
Matrix Publishers, Inc.
Over 500 pp., $17.95

A comprehensive dictionary to all terms used in the microcomputer field. Includes useful appendices on mathematical and statistical definitions, acronyms and abbreviations, number systems and language summaries.

Addresses of Book Publishers:

Matrix Publishers, Inc.
207 Kenyon Rd.
Champaign, IL 61820

John Wiley & Sons, Inc.
605 Third Ave.
New York, NY 10016

Osborne & Associates, Inc.
2950 Seventh St.
Berkeley, CA 94710

Dymax
PO Box 310
Menlo Park, CA 94025

73 Magazine
Peterborough, NH 03458

Science Research Associates
1540 Pagemill Rd.
Palo Alto, California

Creative Computing Press
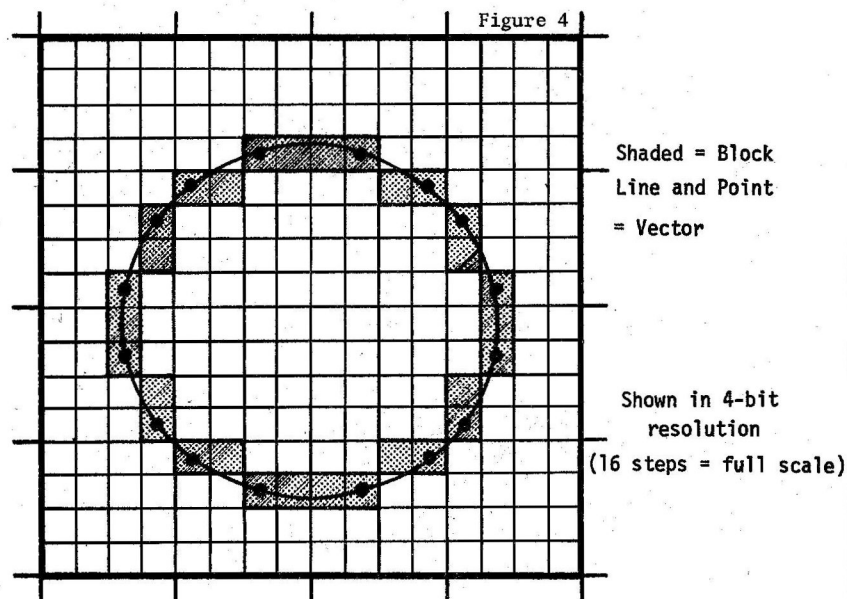PO Box 789-M
Morristown, NJ 07960

Cambridge University Press
32 E. 57th St.
New York, NY 10022

Hayden Book Co.
50 Essex St.
Rochelle Part, NJ 07662

Northern Technology Books
Box 62
Evanston, IL 60204

E&L Instruments, Inc.
61 First St.
Derby, CT 06418

Figure 4

Shaded = Block

Line and Point = Vector

Shown in 4-bit resolution

(16 steps = full scale)

Figure 5 is a flow chart provided to aid in writing a program to do a free-hand drawing using a joystick.

Another possible option is the addition of a program to draw the current location of the joystick as a small square and only record new points when a sense switch is up. An erase function can be implemented in a similar manner.

2. Circuit Analysis

Another application of the 88-AD/DA Converter in an engineering lab is DC parameter testing in amplifier design. The objective is to manipulate a couple of parameters under the control of the computer and measure resulting variations using other parameters. Possible parameters under the control of the computer are supply voltage and bias voltage. Each can be controlled through a programmable power supply, or the bias voltage can be controlled directly. As these parameters are changed, the resulting variations in other parameters are acquired and measured by the Multiplexer and Analog-to-Digital Converter. The computer stores these measurements in memory for possible later print-out or graph plotting.

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION   CONTINUED

Clubs:

New microcomputer clubs are being formed every day all over the country. They provide an excellent opportunity to pool knowledge and resources. The following list includes just a few of these computer clubs. Check with your local computer store or a hobbyist magazine for additional clubs.

Pittsburgh Computer Club
Fred Kitman
400 Smithfield St.
Pittsburgh, PA 15222

The Computer Hobbyist Group
N. Texas
2377 Dalworth 157
Grand Prairie, TX 75053

Valley Chapter SCCS
R. Stuart Gibbs
5652 Lemona Ave.
Van Nuys, CA 91411

El Paso Computer Group
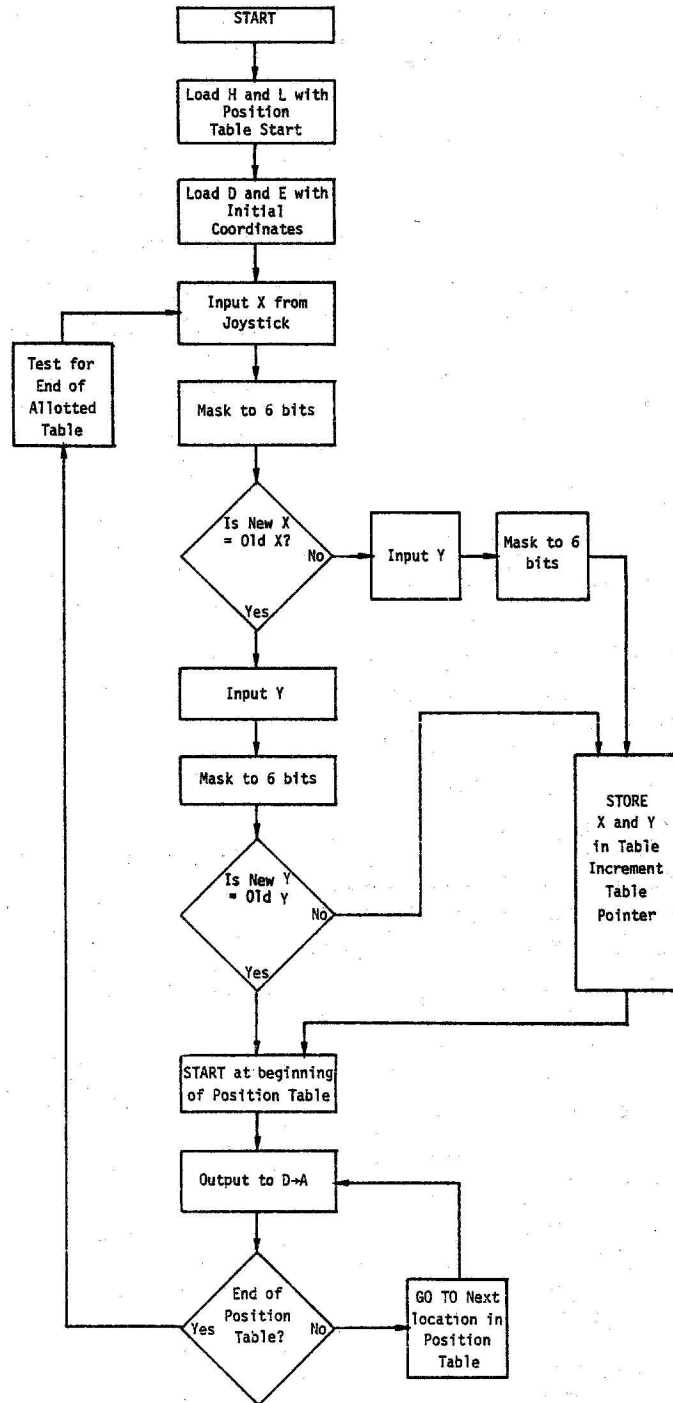c/o Al Schatte
9716 Saigon Dr.
El Paso, TX 79925

Figure 5

Altair AD/DA Subsystem
Reads and Generates Analog Signals
CONTINUED

Listed below are measurable parameters and the necessary hardware to obtain the measurements:

Parameters

Supply Current	Current Shunt and Instrumentation Amp
Bias Current	Current Shunt and Instrumentation Amp
Output Offset Voltage	Instrumentation Amp
Input Offset Voltage	Instrumentation Amp
Internal Bias Points	Voltage Divider or Amp
Temperature (such as output transistors)	DC Temperature Transducer and Amplifier

Possible tests include:

    a) Offset vs. Supply
    b) Temperature vs. Bias
    c) Temperature vs. Supply
    d) Power Consumption vs. Bias
    e) Internal Bias vs. Bias

The 88-AD/DA Converter board can also be used to test frequency response. Again, possible parameters under control of the computer are the supply voltage and bias voltage. Some possible tests are:

    a) Frequency Response
    b) Gain vs. Frequency
    c) Frequency vs. Bias

PUBLICATIONS PROVIDE NOVICE WITH ESSENTIAL INFORMATION   CONTINUED

Crescent City Computer Club
1119 Pennsylvania Ave.
Slidell, LA 70458

Wisconsin Area Computer Society
PO Box 159
Sheboygan Falls, WI 53085

Mid Michigan Microcomputer Group
William J. Serviss
13121 Tucker
De Witt, MI 48820

Southern California Computer Society
Louis G. Fields, Vice President
11662 Sunset Blvd., Suite 2
Los Angeles, CA 90049

Homebrew Computer Club
193 Thompson Square
Mt. View, CA 94043

South Florida Computer Group
Roberto Denis
4765 NW 4 Ct.
Plantation, FL 33317

Washington-Baltimore Computer
Hobbyist Club-R. Rubinstein
7711 Elba Rd.
Alexandria, VA 22306

Amateur Computer Group of N.J.
UCTI 1776 Raritan Road
Scotch Plains, NJ 07076

Portland Computer Society
c/o Joe Bartel-Ratedata, Inc.
3243 N.E. Sandy Blvd.
Portland, OE 97232

CACHE
PO Box 36
Vernon Hills, IL 60061

Northwest Computer Club
c/o Steve Petchen
1334 N. 122
Seattle, WA 98133

Houston Amateur Microcomputer Club
c/o Troxell Ballou
3842 Grennoch
Houston, TX 77025

Permian Basin Computer Group
c/o John Rabenaldt
Ector County School District
820 MacArthur St.
Odessa, TX 79763

San Diego Computer Society
3649 Mount Everest Blvd.
San Diego, CA 92111

Southern New England Computer Society
267 Willow Street
New Haven, CT 06511

BCCS
c/o Karl Brackhaus
203-1625 W. 13th
Vancouver, Canada V6J 2G9

ASDC SEEKS USER'S HELP

The Altair User Group Software Library is one of the largest and most active user group libraries in existence. Your continuing interest and support will make it easier for other Altair users around the country to make the most effective use of their equipment.

Program Corrections

The Altair User Group Software Library is soliciting any corrections that Altair users identify in software distributed by the Library. Users should send a correction page that can be reproduced and put in the program file to be distributed to other Altair users, to:

User Group Library Administrator
Suite 343
3330 Peachtree Road
Atlanta, Georgia 30326

Software credit coupons will be given to users who submit corrections.

Programs in Machine Readable Form

Altair computer users are encouraged to submit machine readable programs on paper tape, cassette or diskette to the User Group Library. The User Group will issue software coupons and replace diskettes or cassettes to users assisting in this effort.

Software Contest Winners for Submissions during December, January and February.

Best Programs

First Place:

#1-18-773
Title: MVT (Multi Task-O/S Kernel)
Author: Darrell J. Van Buer
        Venice, CA

Second Place:

#1-18-774
Title: 12-Tone-Row Generator
Author: John R. Lynch, Sr.
        Lake Oswego, OR
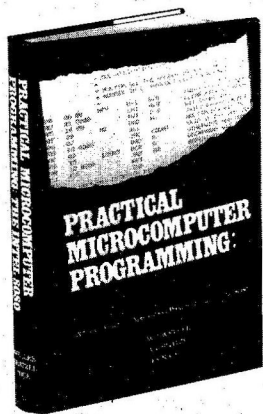
Second Place (Tie):

#1-18-771
Title: PROMON2 (a 1-K Monitor)
Author: Alan R. Miller
        Socorro, NM

Third Place:

#2-16-771
Title: Wumpus
Author: Ron Santore
        San Luis Obispo, CA

ALTAIR COMPUTER CENTERS

BEAVERTON, OR 97005
8105 SW Nimbus Ave.
(503)-644-2314

BERKELEY, CA 94710
1044 University Ave.
(415)-845-5300

SANTA MONICA, CA 90401
820 Broadway
(213)-451-0713

DENVER, CO 80211
2839 W. 44th Ave.
(303)-458-5444

ALBUQUERQUE, NM 87110
3120 San Mateo N.E.
(505)-883-8282;883-8283

TUCSON, AZ 85711
4941 East 29th St.
(602)-748-7363

LINCOLN, NB 68503
611 N. 27th St.
Suite 9
(402)-747-2800

LITTLE ROCK, AR 72206
2412 Broadway
(501)-371-0449

TULSA, OK 74135
5345 East Forty First St.
110 The Annex
(918)-664-4564

HOUSTON, TX 77036
5750 Bintliff Drive
(713)-780-8981

RICHMOND, VA 23230
4503 West Broad St.
(804)-335-5773

SPRINGFIELD, VA 22150
6605A Backlick Rd.
(703)-569-1110

CHARLESTON, W. VA. 25301
Municipal Parking Building
Suite 5
(304)-345-1360

EAGAN, MN 55122
3938 Beau D'Rue Drive
(612)-452-2567

ANN ARBOR, MI 48104
310 East Washington Street
(313)-995-7616

WINDSOR LOCKS, CT 06096
63 South Main Street
(203)-627-0188

PARK RIDGE, IL 60068
517 Talcott Rd.
(312)-823-2388

ST. LOUIS, MO 63130
8123-25 Page Blvd.
(314)-427-6116

NASHVILLE, TN 37203
1600 Hayes St.
Suite 103
(615)-329-1979

BURLINGTON, MA 01803
120 Cambridge St.
(617)-272-8770

ALBANY, NY 12211
269 Osborne Road
(518)-459-6140

NEW YORK, NY 10018
55 West 39th St.
(212)-221-1404

ATLANTA, GA 30305
3330 Piedmont Road
(404)-231-1691

TAMPA, FL 33614
5405 B Southern Comfort Blvd.
(813)-886-9890

3330 Peachtree Road, Suite 343
Atlanta, Georgia 30326

Have you written Software for your Altair[T.M.] Computer?

The Altair 8800 computer was the first micro produced for the general public and remains number one in sales, with more than 8,000 mainframes in the field. The wide acceptance of the Altair computer and its rapid adaptation to many diversified applications has truly turned the dream of the affordable computer into a reality.

Yet the machine itself, remarkable as it is, represents only the beginning. The right Software, tailored to meet a user's specific requirements, is a vital part of any computer system. MITS wants to insure that Altair users everywhere have the best applications software available today and in the future. For this reason, a new MITS subsidiary, the ALTAIR SOFTWARE DISTRIBUTION COMPANY, has been formed. Its purpose: to acquire the highest quality software possible and distribute it nationally through Altair Computer Centers.

That's where you come in. The ASDC will pay substantial royalties to the originators of all software accepted into the ASDC library. If you have written business, industrial or commercial use software for the Altair 8800, ASDC wants to hear from you. It is the aim of the ASDC to stimulate and reward creativity in producing useful software that makes those dreams of "computers for everyone" come true. The ASDC will select only software that measures up to its high standards for system design, coding and documentation. The software will then be further documented and distributed through Altair Computer Centers around the country.

For more information on how to submit software to the ASDC, ask your Local Altair Computer Center for an ASDC Software Submittal Packet or contact the ALTAIR SOFTWARE DISTRIBUTION COMPANY.

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ASDC
ALTAIR SOFTWARE DISTRIBUTION COMPANY
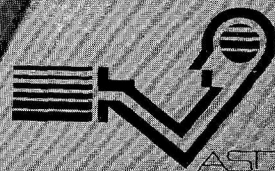3330 Peachtree Road, Suite 343   Atlanta, Georgia 30326   404-231-2308

How does a small business fully realize the cost-effectiveness of a microcomputer? One major consideration is the right software. And the right office software is now available at all Altair™ Computer Centers. It's the Altair Business System—a total office management software package for all Altair 8800-based systems.

The Altair Business System brings accounting, word processing and inventory management software into your office at a surprisingly low cost.

The accounting packages include a flexible general ledger package that allows a business to keep a timely, detailed general ledger of all transactions and provide up-to-date financial reports for management. Packages for receivables, payables and payroll functions keep subsidiary ledgers current and produce automatic invoicing statements, check writing, 941s, W-2s and other required reports. The word processing system is an extremely flexible text editor that allows large volume text material, such as contracts, to be easily modified and printed. In addition, documents can call for inserts from other files, making repetitive letters very easy to produce. The inventory management system is an extremely flexible data base that allows complete inventory records to be kept on line. The package is designed to permit custom structuring of inventory files and reports.

Do something good for your business. Contact your local Altair Computer Center or the Altair Software Distribution Company directly for more information about the Altair Business System.

Good for Business

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